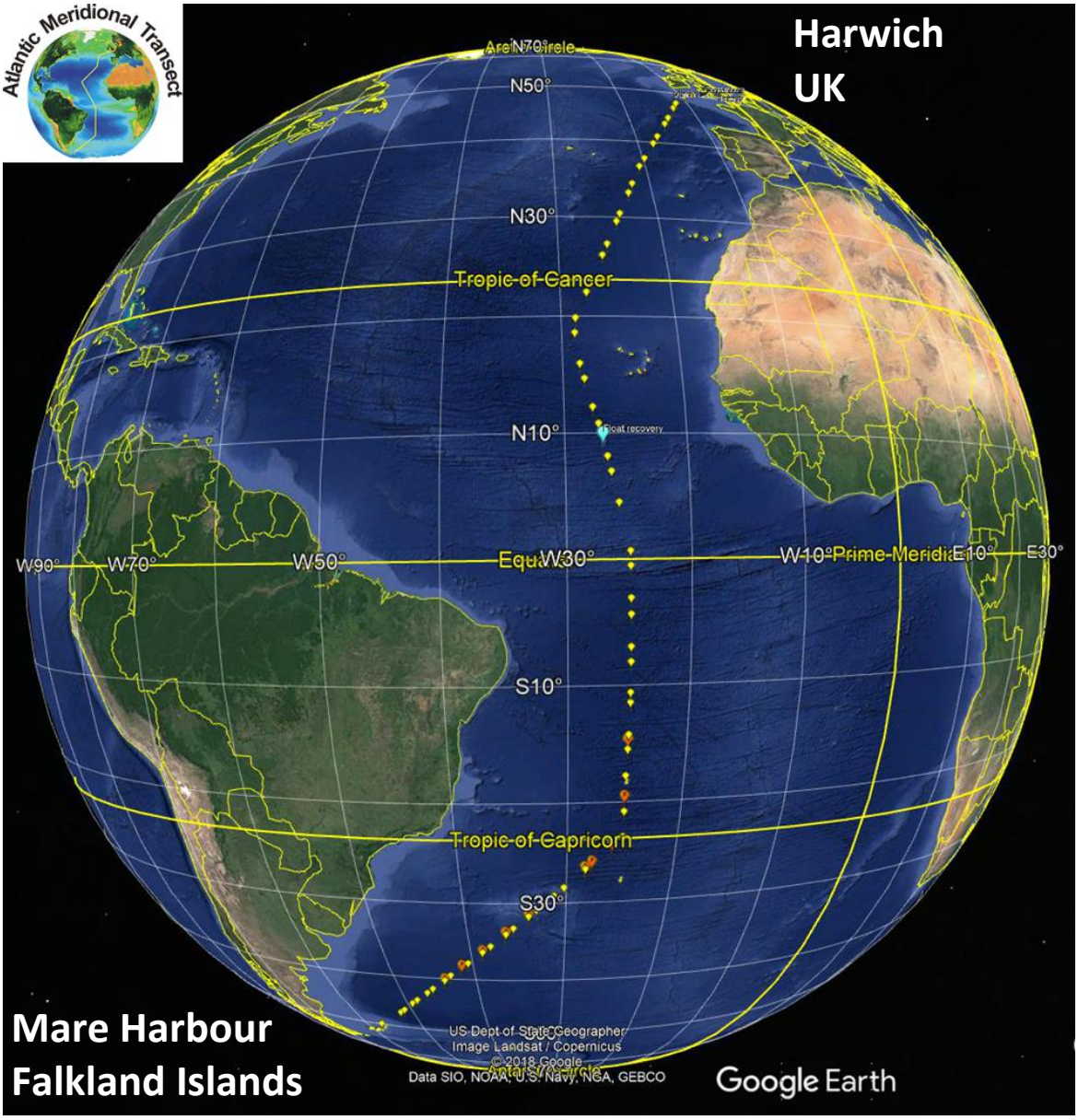
AMT 28 CRUISE REPORT



RRS James Clark Ross (JR18-001)

23 September – 29 October 2018

Chief Scientist – Glen Tarran
Plymouth Marine Laboratory

PML Plymouth Marine Laboratory | NERC SCIENCE OF THE ENVIRONMENT | esa | REMAIN | pogo

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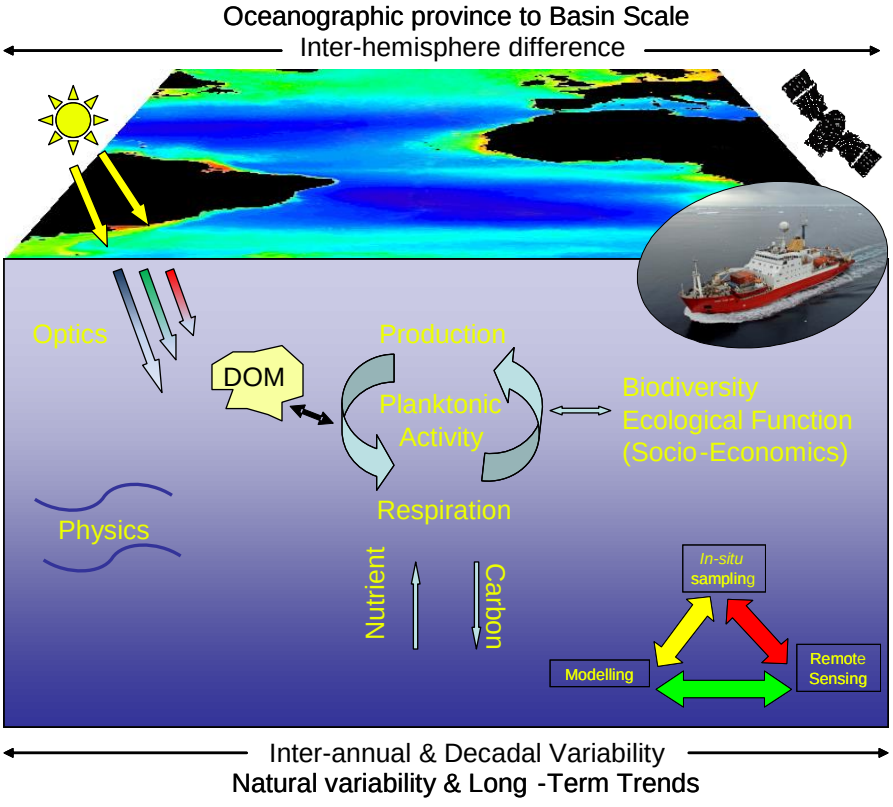
The Atlantic Meridional Transect programme

The overall aim of the Atlantic Meridional Transect programme is funded as part of the Natural Environmental Research Council's National Capability. It's internationally important remit is to quantify key biogeochemical and ecosystem processes and their inherent variability over extended time and spatial scales in the Atlantic Ocean. This is achieved by executing an annually repeated meridional transect through contrasting oceanic provinces, ranging from oligotrophic deep blue waters, to highly productive shelf seas.

The specific objectives of the AMT are:

- To quantify the nature and causes of ecological and biogeochemical variability in planktonic ecosystems.
- To quantify the effects of this variability on nutrient cycling, on biogenic export and on air-sea exchange of climate active gases.
- To construct multi-decadal, multidisciplinary ocean time-series which are integrated within a wider "Pole-to-pole" observatory concept.
- To provide essential sea-truth validation for current and next generation satellite missions
- To provide a valuable, highly sought after and unique training arena for the next generation of UK and International oceanographers.
- To provide essential data for global ecosystem model development and validation; which in turn provides the world with its climate change forecast capability.



Data sets are publicly available, with CTD profiles and underway surface time series available online at: www.bodc.ac.uk/projects/uk/amt/.The remaining AMT data sets are available on request to BODC or they will advise who to contact for recent data sets.

Cruise Overview

The AMT 28 research cruise (JR18-001) set sail from Harwich on 23rd September, 2018 aboard the Royal Research Ship James Clark Ross, and arrived in Mare Harbour, Falkland Islands on 29th October 2018.

RRS James Clark Ross alongside at Mare Harbour, Falkland Islands

The highlights of AMT28 were as follows:

- Launch of 13 Argo and Biogeochemical-Argo floats, on behalf of the SOCCOM programme, USA, University of Washington, USA and UK Met Office, in the sparsely sampled South Atlantic;
- Recovery of a Bio-Argo float in the tropical Atlantic, following a 4 year deployment.

Bio-Argo float recovered on 7th October

- Recovery of a deep (5000 m) sediment trap mooring in the South Atlantic Oligotrophic Gyre for the National Oceanography Centre, UK, which had previously been deployed in October 2017, and the construction and deployment of a new sediment trap mooring at the same location.

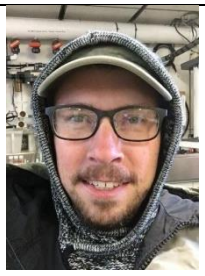
- 63 CTD profiles at stations spaced approximately 200 nM apart, measuring key physical and biogeochemical parameters including: temperature, salinity, chlorophyll, oxygen, nutrients, pH, alkalinity, plankton abundance, respiration, genetics and microbial dynamics.
- 1000s of underway temperature, bio-optical and biogeochemical measurements covering an almost 100° range in latitude and vastly contrasting ocean biomes.
- Continuous acoustic sensor operation to probe positions of marine organisms in the water column.
- 29 vertical net hauls to determine the abundance of different species of zooplankton and larger phytoplankton.
- 28 weather balloon launches.
- 30 optics rig deployments to measure optical properties of the upper 300 m of the water column.
- 63 surface ocean temperature sensor deployments.
- Participation of 19 research scientists from 8 institutes (UK, USA, The Netherlands, France, Spain, Portugal, South Africa).
- Encounters with and circumnavigation of icebergs between 45.5 and 48 ^{o}S.

Various aspects of an iceberg circumnavigated on 27th October at 48^{o} S

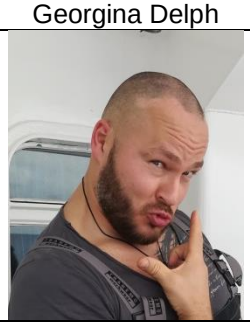
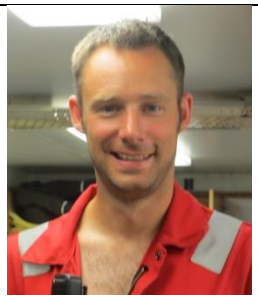
All the scientists would like to acknowledge the exceptional work of the Officers and crew of the JCR and the NMFSS and AME technical support teams, for making this a successful and highly enjoyable research cruise. I would like to thank Andy Rees and Christina Pardos-Bradley of PML for all of their cruise planning and logistics support.

Dr Glen. A Tarran, Chief scientist AMT28 (JR18-001).
Plymouth Marine Laboratory. April 2019

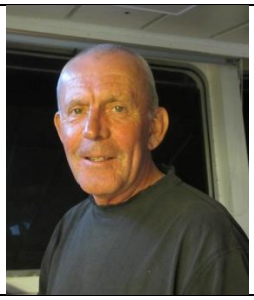
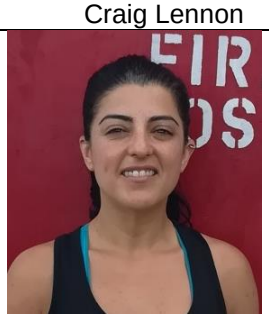
AMT28 Cruise Participants – Scientists

			
Afonso Ferreira	Alyse Larkin-Swartout	Andreia Tracana	Arwen Bargery
			
Bob Brewin	Carol Robinson	Cecilia Liszka	Chata Seguro
			
Fred Wimmer	Giorgio Dall'Olmo	Glen Tarran	Hans Slagter
			
Ian Murdoch	Igor Fernández	Jenna Lee	John Ballard
			
Millie Goddard-Dwyer	Natalia Llopis Monferrer	Rebecca May	Wade De Kock

AMT28 Cruise participants – Ship's personnel

			
Captain Graham Chapman	1st officer Georgina Delph	2nd officer Dominik Muller-Tolk	3rd officer Sam Vargas
			
3rd officer Scott Cramman	Chief engineer Andris Kubulins	2nd engineer Chris Donaldson	3rd engineer Alek Hardy
			
4th engineer Steve Eady	Deck engineer Rob Sutton	ETO comms Patrick O'Hara	ETO Doug Stevens
			
Purser Lloyd Sutton	Chief cook Brian Robertson	2nd cook Dave Tucker	Snr steward Derek Lee
			
Steward Tom Patterson	Steward Olly Burch	Steward Mick Anderson	

AMT28 Cruise participants – Ship's personnel

			
Science bosun Cliff Mullaney	Deck Bosun Chris Littlehales	Bosun's mate John O'Duff	Motorman Carlos Vargas Leon
			
Motorman Steve Pictor	Seaman Craig Lennon	Seaman Martins Neilands	Seaman Alan Howard
			
Seaman Chris Devitt	Seaman Paula Munoz Garcia	AME technician Sean Quirk	IT technician Sean Vincent
			
IT technician David Hunter	Lab manager Aisling Smith	Doctor Amber Chadwick	

Science reports

Sea Surface Temperature – AMT4OceanSatFlux

Werenfrid Wimmer
University of Southampton

Objectives:

Collect SI traceable SSTskin measurements for the validation of SLSTR on the ESA Sentinel 3 satellite. Collect the necessary ancillary measurements for the SSTskin record to help the interpretation of the validation results. Extend the ISAR SSTskin record geographically to cover a wider range of oceanographic regimes.

Collect SSTdepth and met data from the ship's underway system for comparison and to complement the SSTskin data set.

Automated collection of SSTskin and meteorological data:

SSTskin data were collected by ISAR (Infrared Sea surface temperature Autonomous Radiometer, 003) mounted on the port side of the forward mast at a 45 degree angle relative to the ship's centre line. The instruments sea-viewing angle was checked on 24/09/2018 and determined with 35 degrees from nadir (145 degrees in instrument coordinates). The ISAR configuration was set to include three sky angles (25, 35, 45 degrees). The data were logged with a data logger based in the Mail Room connected to the ship's network, allowing for frequent data quality checks. The data logger suffered an SD card failure on reboot on 21/10/2018, which was fixed by replacing the card with a spare card. ISAR 003 suffered intermittant reboot errors, hanging on scan/shutter motor movement, from the 26/10 onwards which were fixed by power cycling the instrument on 26/10 at 13:47 and on 27/10 at 04:30.

A second ISAR (012) was installed on the Monkey island, port side for comparison of SSTskin and uncertainty values with the mast ISAR and to check on the ship's wake influence on the SSTskin measurements. This ISAR was configured with two sea-viewing angles, 35 and 25 from straight downward-looking (145 and 155 instrument coordinates) and 4 sky angles (15, 25, 35, 45). After checking the ship's wake pattern in higher seas on 13/10/2018 an extra sea view at 45 (135 in instrument coordinates) and a 55 degrees sky angle were added. ISAR 012 suffered a 12V supply failure on 25/09/2018 after trying to free a stuck shutter. The instrument was removed and after repair with a spare 12V supply module, was recalibrated and reinstalled on 26/10/2018. To avoid any further issues the shutter was disabled and left open for the rest of the cruise. The rain gauge also failed at the same time as the 12V supply. A spare rain gauge was installed when the instrument was reinstalled. The GPS stopped working after the 12V regulator failure, but no sapres were available and the ship's GPS data is used for geolocation information on ISAR 012. The spare rain gauge gave false positive readings and, as no more rain gauges were available, the rain limit was raised to 2.5V and the rain gauge was packed with silica bags. This seemed to work reasonably well to the end of the cruise. The multiple sky and sea view angles were set up to help with the mis-pointing characterization as described by Donlon and Nightingale, 2000 and the changes have no impact on the use of the ISAR data for SLSTR validation.

The ancillary sensors, a Kipp and Zonen CM11, an Eppley PIR and a Gill Windmaster were mounted on the bird table in order to be free of obstruction for the Gill Windmaster, and to have a clean view of the sky for the CM11 and the PIR. The CM11 and the PIR were mounted on individual gimbals to ensure that the sensors' axes were vertical even when the ship moved. The data were logged with the same logger as the ISAR data. The PIR data was processed as described in Fairall et. al. 1998.

Air temperature and humidity data were collected with a Vaisala HMP243 sensor on the port side of the monkey island with the ISAR 012 data logger which was located in a computer room just behind the bridge.

SSTdepth (at 4m) data were collected with a Seabird SBE48 in the port side void space. A total of 198963 samples were collected at 20 second intervals.

Together with the ISAR instruments, time lapse images were recorded at the mast and monkey island of the sea and sky every 10 seconds to aid data interpretation.

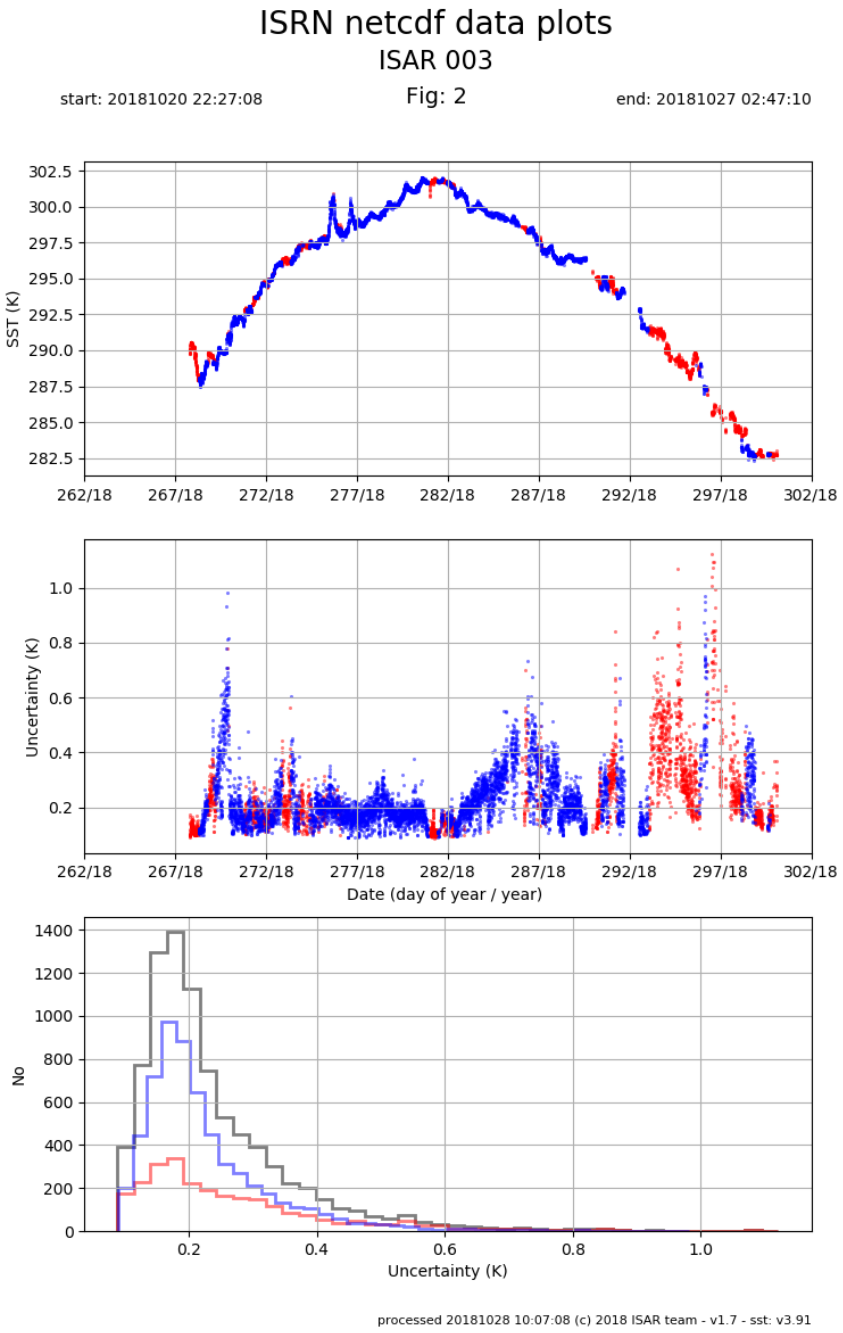


Figure 1: ISAR 003 SST data with corresponding total uncertainty.

Sky Brightness temperature measurements

In order to characterize the mis-pointing uncertainty of the ISAR instrument (Donlon and Nightingale, 2000; Wimmer and Robinson, 2016) and characterize the whole sky, a Heitronics KT 15 was mounted on a three axis motor-driven mount, which also recorded temperature, roll and pitch and GPS date/time and location. A sky BT characterization took approximately 30 min. Together with the KT 15, an all-sky camera was mounted, filming during the KT15 data acquisition in a 1 s time lapse mode. Also, a number of infrared images of the sea and sky were taken with a FLIR E4/8 during each of the KT 15 data acquisitions. A total of 9 Sky brightness temperature characterizations were acquired, mainly at the noon CTD station, with one at the morning CTD station and two at the extended second 1000 m CTD station. Both the KT15 mount and the all-sky camera were mounted on the Monkey island on the port side above the ISAR 012 on top of the two scaffolding poles. The Heitronics KT15 was calibrated with a CASOTS II black body before and after each measurement, with a two point calibration at roughly 290 K and 303 K in the Wet laboratory.

Figure 2: Sky camera and Heitronics KT15 mounted on the monkey island .

Table 1: Sky Brightness Temperature measurements date, time and location.

No	Date	Time	Lat (+ N)	Lon (E)
1	29/09/2018	12:40	38.63084	-18.52568
2	30/09/2018	13:54	35.302	-20.91522
3	02/10/2018	11:50	28.60906	-24.36087
4	04/10/2018	13:56	21.44719	-27.74536
5	10/10/2018	13:55	-1.15042	-24.98211
6	13/10/2018	11:45	-12.08282	-24.93029
7	14/10/2018	13:59	-16.03239	-25.02353
8	19/10/2018	13:54	-30.00593	-31.14971
9	27/10/2018	15:42	-48.19867	-52.69284

References:

Donlon, C. J. and Nightingale, T. J. (2000); Effect of Atmospheric Radiance Errors in Radiometric Sea-Surface Skin Temperature Measurements; Appl. Opt.; 39: pp. 2387–2392.

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Donlon ,CJ., W. Wimmer, I. Robinson, G. Fisher, M. Ferlet, T. Nightingale, and B. Bras, 2014: A second-generation blackbody system for the calibration and verification of sea- going infrared radiometers. J. Atmos. Oceanic Technol., 31, 1104–1127, doi:10.1175/JTECH-D-13-00151.1.

Wimmer, W., I. Robinson, and C. Donlon, 2012: Long-term validation of AATSR SST data products using shipborne radiometry in the Bay of Biscay and English Channel. Remote Sens. Environ., 116, 17–31, doi:10.1016/j.rse.2011.03.022.

Wimmer, W., and I. Robinson, 2016: The ISAR instrument uncertainty model. J. Atmos. Oceanic Technol. doi:10.1175/JTECH-D-16-0096.1, in press.

Fairall, C. W., Persson, P. O. G., Bradley, E. F., Payne, R. E. and Anderson, S. P. (1998); A newlook at calibration and use of Eppley Precision Infrared Radiometers. PartI: theory and application; J. Atmos. Oceanic Technol.; 15: pp. 1229 – 1242.

Weather Balloon – AMT4OceanSatFlux

Werenfrid Wimmer and Aisling Smith
University of Southampton and British Antarctic Survey

Objectives

Collect lower atmosphere profiles to aid the atmospheric radio transfer models of the Sentinel 3 satellite sensors.

Method

Weather balloons, measuring air pressure, humidity, temperature, wind speed and direction were launched daily to collect information of the lower atmosphere composition. A total of 28 balloons were launched between 28/09/2018 and 26/10/2018. The radiosondes used were Vaisala RS92, which were reconditioned before launch with the Vaisala GC25. A Vaisala Digicora II MW15 together with a

dedicated BAS laptop were used as the data receiving and storing devices. The data receiving and GPS antenna were mounted on the Met platform, the Vaisala GC 25, MW15 and the laptop were located in the UIC. The balloons were inflated with helium, with the helium bottle rack being located behind the bridge, along with a BAS-provided balloon filling cage. The balloons were launched from the rear end of the Bridge deck. Data were emailed post-flight to the UK Met Offcie with send_temp_MW15.vi .

Table 2: List of radio sonde launch dates and locations.

No.	Date	Time (UTC)	Lat (+N)	Lon (E)
1	27/09/18	12:26:00	45.010	-13.580
2	28/09/18	12:09:00	41.930	-16.020
3	29/09/18	12:18:00	38.630	-18.530
4	30/09/18	13:20:00	35.300	-20.920
5	01/10/18	13:16:00	31.550	-22.420
6	02/10/18	13:34:00	28.610	-24.360
7	03/10/18	13:10:00	25.050	-26.050
8	04/10/18	13:05:00	21.450	-27.750
9	05/10/18	13:27:00	17.740	-28.930
10	06/10/18	13:20:00	13.810	-28.290
11	07/10/18	13:18:00	10.100	-27.290
12	08/10/18	13:11:00	06.260	-26.380
13	10/10/18	13:15:00	-1.150	-24.990
14	11/10/18	13:15:00	-4.985	-24.970
15	12/10/18	13:15:00	-8.765	-24.950
16	13/10/18	13:20:00	-12.085	-24.930
17	14/10/18	13:10:00	-15.035	-25.030
18	16/10/18	13:14:00	-21.600	-25.050
19	17/10/18	13:19:00	-24.905	-25.903
20	18/10/18	11:27:00	-27.200	-28.250
21	19/10/18	13:15:00	-30.010	-31.150
22	20/10/18	14:15:00	-32.375	-33.670
23	21/10/18	13:27:00	-34.580	-36.090
24	22/10/18	13:16:00	-37.010	-38.830
25	23/10/18	13:38:00	-39.210	-41.470
26	24/10/18	13:20:00	-41.370	-44.010
27	25/10/18	14:24:00	-43.790	-46.950
28	26/10/18	14:38:00	-46.020	-49.870

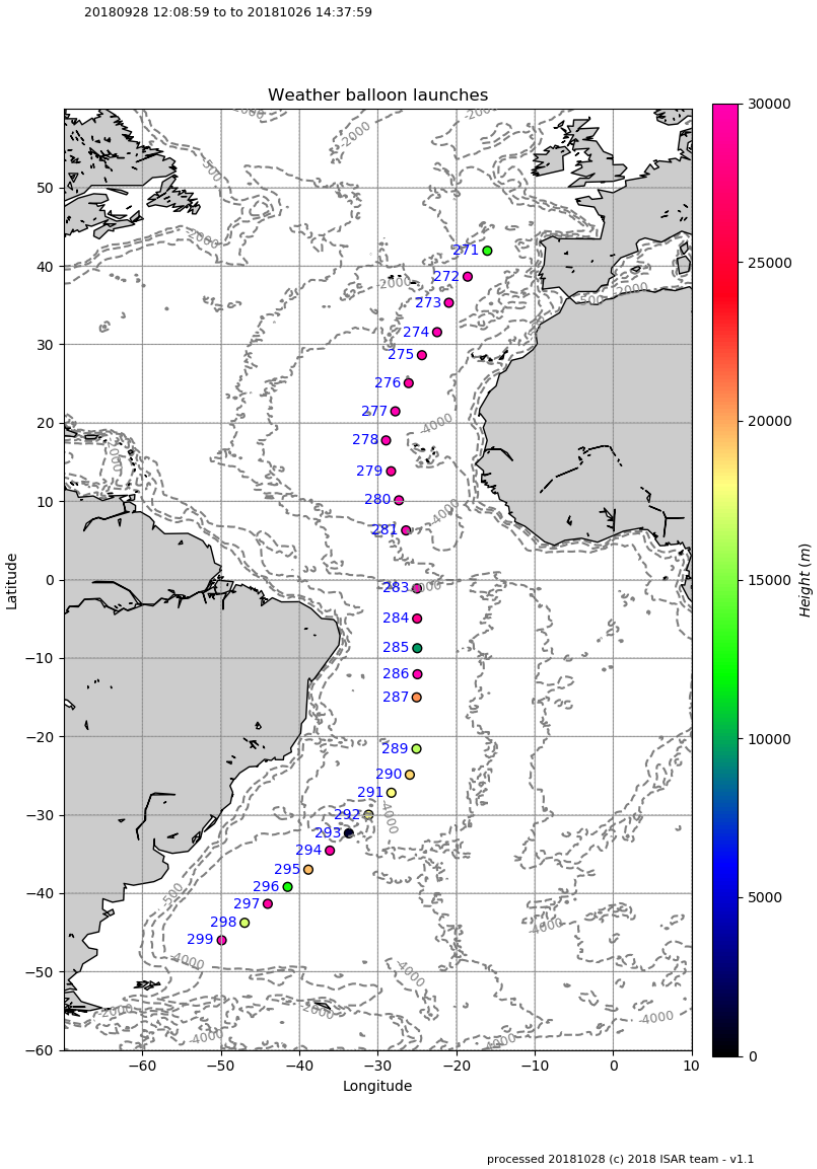

Figure 3: Plot of the Balloon launch positions with day of year labels in blue. The colour of the circle represents the height above sea level at which the balloon burst.

C-band Radar – AMT4OceanSatFlux

Werenfrid Wimmer
University of Southampton

Objectives

Collect sea state, surface roughness and wave information for the validation of the ESA Sentinel 3 satellite radar altimeter and the synthetic aperture radar on the ESA Sentinel 1 satellite.

Methods.

The IFREMER shipborne C-band radar was mounted on the forward mast facing the port side of the ship at an angle of approximately 45 degrees horizontally. The radars look angle at the sea surface is fixed at approximately 40 degrees. The radar instrument is viewing roughly the same patch of water the ISAR instrument is, but the two instruments have very different fields of view. The radar images have some contamination of the ship's gunwale in them, however, this can be removed in post-

processing. Data were recorded every 20 minutes in the forecastle mail room on a dedicated IFREMER data logging computer. Data quality was checked during the cruise on a regular basis. Together with the C-band radar 480 camera images (over approximately 5 min) were collected every 20 min to help interpret the radar data.

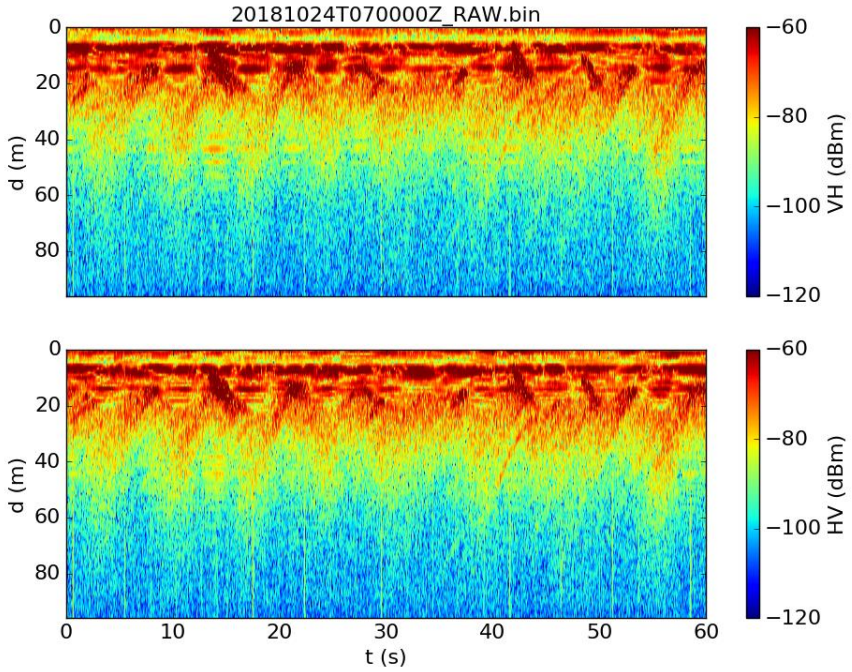

Figure 4: Example radar image from 24/10/2018 showing the vertical horizontal and horizontal vertical polarization data.

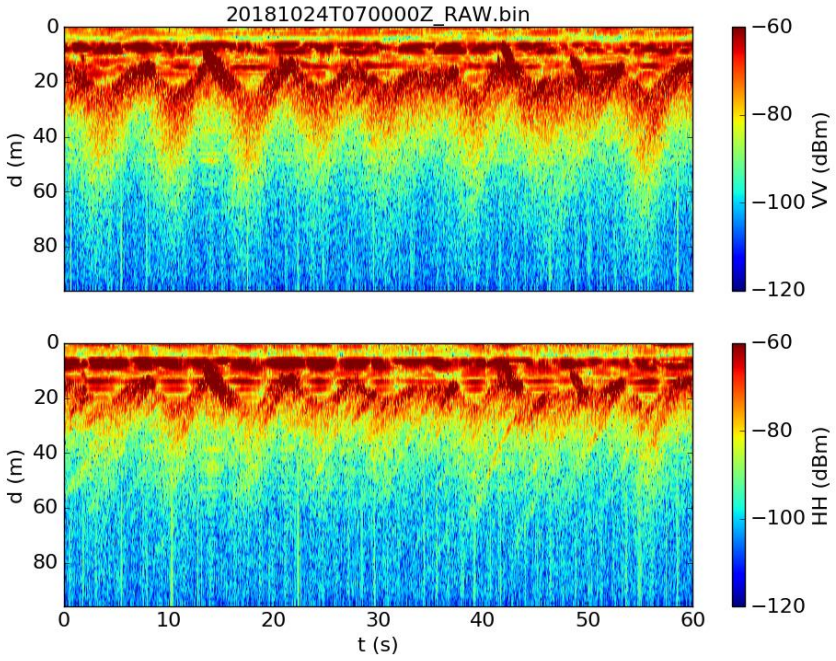

Figure 5: Example radar image from 24/10/2018 showing the vertical vertical and horizontal horizontal polarization data.

Collection of Surface Measurements of Water Temperature using a Small Oceanographic floating Device (SOD)

Bob Brewin[1], Werenfrid Wimmer[2] & Giorgio DallOlmo[1]
1. Plymouth Marine Laboratory, UK
2. University of Southampton, UK

Cruise Objectives

There were two objectives to the design, development and operation of the Small Oceanographic floating Device (SOD) on AMT28.

1) Test, calibrate and inter-compare a surfboard fin (Smartfin), developed to measure sea surface temperature when surfing, with a suite of other instruments on the JCR designed to measure sea surface temperature, including: the profiling CTD; the underway CTD system; and the Infrared Scanning Autonomous Radiometer (ISAR).
2) Characterise the near-surface water temperature profile to test models designed to extrapolate skin temperature measurements, observable via satellite thermal sensors, to deeper depths.

Methods

Two surfboard fins were attached on the underside of a Small Oceanographic floating Device (SOD). The SOD itself is a swimming float with future fin sockets integrated (for attaching the fins) and two bodyboard plugs for attaching rope to either side of the float (see Figure 1). One of the surfboard fins that was attached to the SOD on AMT28 was a Smartfin (https://smartfin.org/), designed to record water temperature (at 10 cm depth), GPS and motion. The fin has bluetooth capabilities allowing the transfer of data onto a mobile phone or tablet equipped with the Smartfin app. This data can then be transferred onto the Smartfin data server and is freely accessible.

On the underside of the SOD, a 1 m rope was attached to a plug. Weights were placed to steady the device when in use at the end of the 1 m rope (Figure 1). On the topside, a 10 m rope was attached for lowering the SOD into the water. For the first half of the cruise, two miniature temperature sensors (Tidbit v2 and ibutton with housing) were attached to the end of the 1 m rope (to the weights) to measure water temperature at 1 m, with a white disk used to shelter the sensors from sunlight. On very hot sunny days, these sensors were also covered with tin foil to minimise any additional heating from sunlight. Unfortunately, on one occasion just south of the equator, this attracted a sea predator (or possibly some form of sea monster), which assumed the miniature foil-covered sensors were prey and they were taken from the SOD and not recovered. Subsequent deployments had weights only attached to the 1 m rope.

The SOD was lowered into the water from the starboard side of the JCR using a 10 m rope. At stations where the currents were pushing the SOD into the side of the JCR, a telescopic rod was used to extend the rope further away from the ship (Figure 1). The sensors were launched prior to each deployment and the SOD was operated for 20 minutes at each station, both predawn and solar noon. Once recovered, the data were downloaded onto a laptop and backed-up on the ship's hard drive. Thanks to the help from both the JCR IT technician and the AME technician, the Smartfin data were transferred daily from the mobile phone onto the Smartfin server, through use of a dongle (Ethernet port in the phone) that allowed access to the internet from the phone. All stations were sampled, with only one station that yielded unsatisfactory data (data removed), owing to high gusting winds lifting the SOD into the air. For subsequent deployments in high winds, increased weight was added to the 1 m rope and the SOD operated well.

On four occasions during the cruise the sensors were calibrated against a NIST-traceable temperature probe at two contrasting temperatures in a water bath. Systematic differences between all sensors on the SOD and the NIST-traceable temperature probe were removed to ensure accurate data.

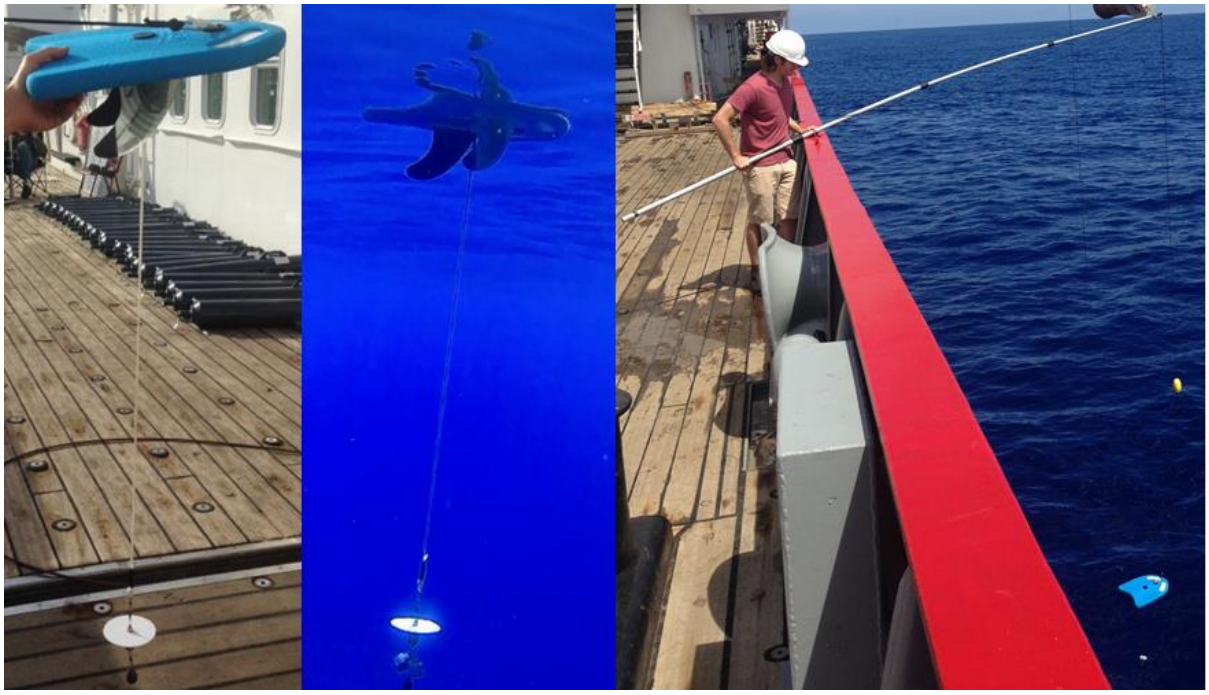

Figure 1. The Small Oceanographic floating Device (SOD). Left on deck prior to deployment, centre underwater shot of the SOD (courtesy of Werenfrid Wimmer) and right, deploying the SOD using a telescopic rod.

Provisional Results

Results from the water bath calibrations are shown in Figure 2. The Smartfin was found to be within 0.003 degrees centigrade of the NIST-traceable temperature probe. The average difference between the probe and the sensors is shown in Figure 2. This difference was removed from each sensor to ensure accurate and consistent measurements. The sensors were found to operate with good stability over the duration of the cruise, with no major drifts between calibrations, as shown in Figure 2.

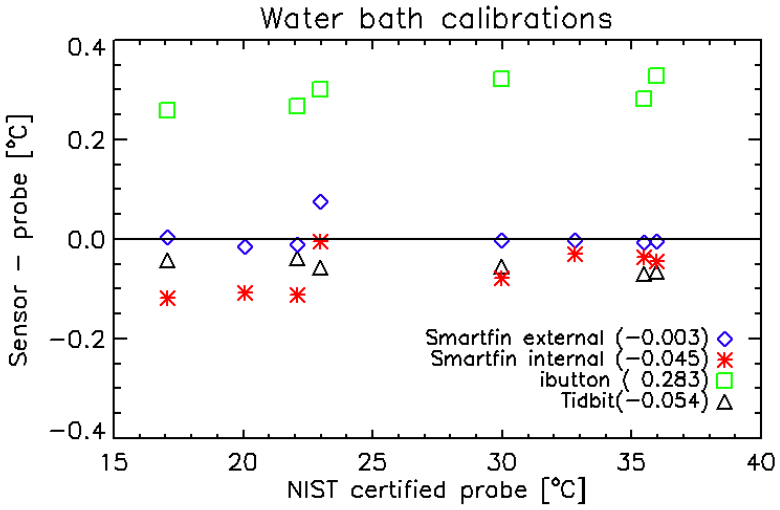

Figure 2. Results from the comparison between SOD sensors and NIST-traceable temperature probe at contrasting temperatures using a temperature controlled water bath.

Figure 3 shows along-track SST as a function of latitude on AMT28 from the underway system, with the Smartfin data overlain. The Smartfin data is shown to track tightly, variations in SST from the underway CTD, suggesting good agreement between the two systems.

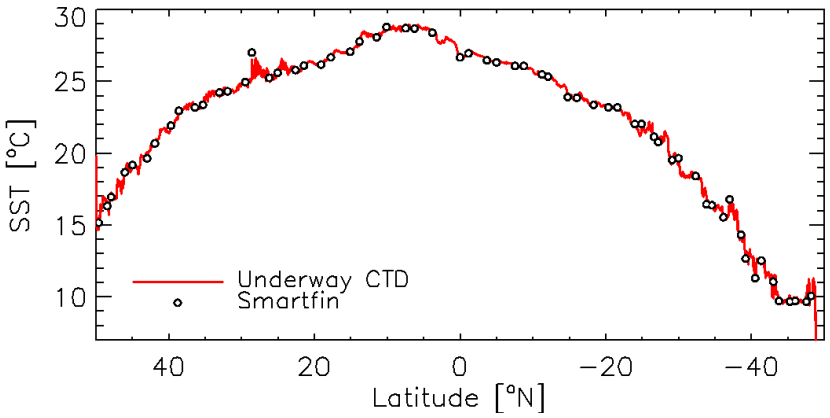

Figure 3. Along-track SST from the JCR underway system with the Smartfin SST data overlain.

Figure 4 shows a histogram of the differences between the Smartfin and the underway SST, as well as the differences between the Smartfin and the ISAR data (preliminary processing), for all the data as well as a partitioning of predawn and noon data. The Smartfin was found to be within <0.05 of the underway (on average) and within <0.1 of the ISAR. Differences within these systems when partitioned into predawn and noon data were consistent with general expectations (Fig. 4), considering the different depths the systems were sampling. Predawn, the expectation (in general and dependant on other environmental conditions) is that the skin temperature from the ISAR (~1 mm) would be cooler than the Smartfin (at 10 cm), but that the Smartfin (at 10 cm) would be cooler than the underway (~5 m), owing to our understanding of the near-surface temperature profile at night. At noon, there was better agreement between systems in general, though significant deviations were observed on occasion, depending on other environmental conditions (e.g. changes in wind-speed and total solar irradiance).

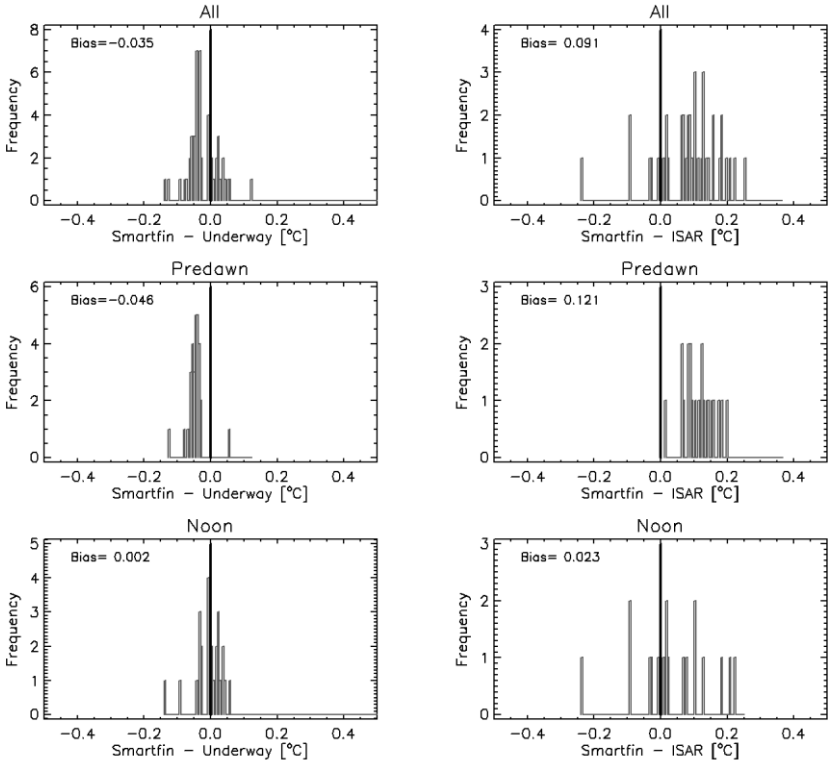

Fig 4. Histograms of the differences between the Smartfin and the underway SST, as well as the differences between the Smartfin and the ISAR data, for all the data as well as a partitioning of predawn and noon data.

Data collected was used to characterise the near-surface water temperature profile for data from the first few mm (from the ISAR) down beyond 100 m depth (CTD). Figure 5 shows two examples of this for two noon stations. The first case (Station 15) where significant surface heating was observed in the upper 10 m, with the temperature significantly higher between 1 mm and 10 cm when compared with data at 1 m and 5 m. In the second case (Station 23), there was excellent agreement between all systems in the upper 10 m. With knowledge of other environmental conditions available from the ship's underway system (e.g. wind speed and irradiance), these data can be used to test models designed to extrapolate skin temperature measurements, observable via satellite thermal sensors, to deeper depths. Table 1 lists locations and times of all SOD deployments.

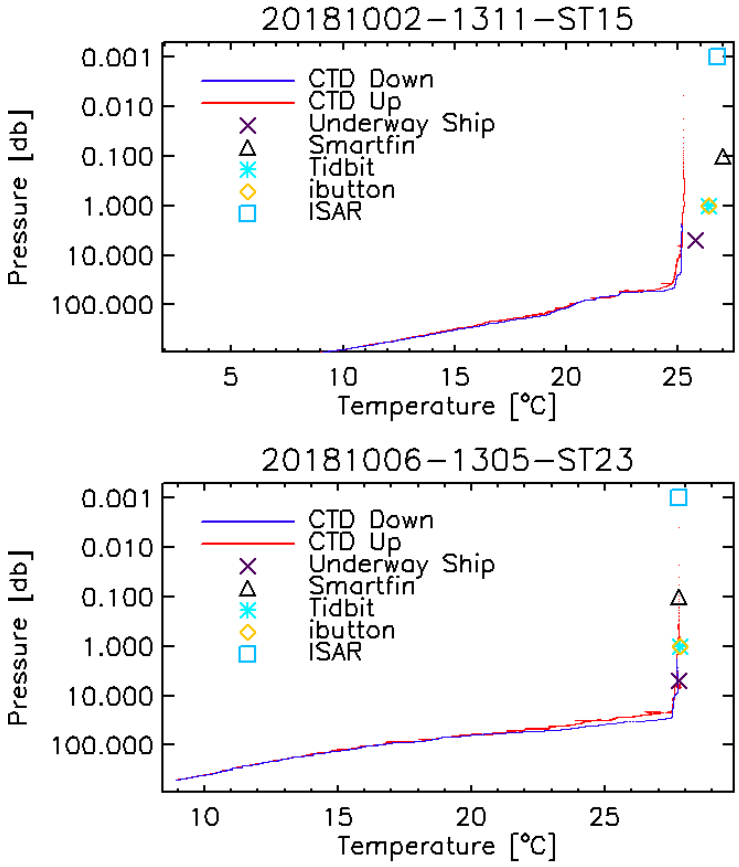

Fig 5. The vertical water temperature profile for data from the first few mm (from the ISAR) to down beyond 100m depth (CTD) for two noon stations during AMT28.

Table 1: SOD deployment times and locations on AMT28

DATE	TIME (GMT)	Station No.	LAT (degrees N)	LONG (degrees E)
25/09/2018	12:49	1	49.6381	-5.5016
26/09/2018	03:39	2	48.4694	-8.8366
26/09/2018	12:13	3	47.9012	-10.3814
27/09/2018	03:32	4	46.0291	-12.7325
27/09/2018	12:13	5	44.9786	-13.5894

28/09/2018	03:42	6	42.967	-15.2131
28/09/2018	12:10	7	41.9117	-16.0363
29/09/2018	03:35	8	39.7193	-17.7161
29/09/2018	12:09	9	38.6309	-18.5257
30/09/2018	04:31	10	36.4139	-20.1215
30/09/2018	13:05	11	35.302	-20.9152
01/10/2018	04:36	12	33.0469	-22.1368
01/10/2018	13:13	13	31.924	-22.7102
02/10/2018	04:37	14	29.4883	-23.9324
02/10/2018	13:11	15	28.6091	-24.3608
03/10/2018	04:32	16	26.2046	-25.5274
03/10/2018	13:19	17	25.0577	-26.0568
04/10/2018	04:33	18	22.5997	-27.2133
04/10/2018	13:05	19	21.4472	-27.7453
05/10/2018	04:34	20	19.0777	-28.8167
05/10/2018	13:04	21	17.7473	-28.9302
06/10/2018	04:34	22	15.0761	-28.6126
06/10/2018	13:05	23	13.8122	-28.2945
07/10/2018	04:35	24	11.447	-27.7087
07/10/2018	13:07	25	10.0982	-27.2938
08/10/2018	04:36	27	7.4713	-26.6501
08/10/2018	13:04	28	6.256	-26.3799
09/10/2018	04:36	29	3.8077	-25.8358
10/10/2018	04:47	30	0.0005	-24.9992
10/10/2018	13:05	31	-1.1518	-24.9906
11/10/2018	04:38	32	-3.6911	-24.9782
11/10/2018	13:07	33	-4.9846	-24.9732
12/10/2018	04:41	34	-7.5487	-24.9574
12/10/2018	13:06	35	-8.7631	-24.9484
13/10/2018	04:33	36	-11.2623	-24.9375
13/10/2018	13:04	37	-12.0828	-24.9303

14/10/2018	04:35	38	-14.7797	-24.9848
14/10/2018	13:11	40	-16.0324	-25.0235
15/10/2018	04:37	41	-18.3393	-25.0857
16/10/2018	04:38	43	-20.3794	-25.0594
16/10/2018	13:08	44	-21.6037	-25.0464
17/10/2018	04:33	45	-23.9996	-24.9994
17/10/2018	13:07	46	-24.9058	-25.9033
18/10/2018	04:39	47	-26.628	-27.6553
18/10/2018	11:12	48	-27.2001	-28.2502
19/10/2018	04:33	49	-29.1276	-30.2235
19/10/2018	13:06	50	-30.0059	-31.1497
20/10/2018	13:18	52	-32.3728	-33.6741
21/10/2018	04:43	53	-33.8316	-35.2688
21/10/2018	13:16	54	-34.5805	-36.0914
22/10/2018	04:35	55	-36.1671	-37.8663
22/10/2018	13:23	56	-37.0121	-38.8346
23/10/2018	04:41	57	-38.5841	-40.6551
23/10/2018	13:19	58	-39.2093	-41.475
24/10/2018	04:43	59	-40.5209	-43.0829
24/10/2018	13:19	60	-41.3697	-44.0127
25/10/2018	04:38	61	-43.006	-45.9817
25/10/2018	14:13	62	-43.7905	-46.9552
26/10/2018	05:34	63	-45.2975	-48.8964
26/10/2018	14:16	64	-46.0175	-49.8723
27/10/2018	06:36	65	-47.5618	-51.7739
27/10/2018	15:15	66	-48.1989	-52.6894

Measurements of Optical Properties

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Goal

- To determine optical properties along the transect in support of satellite calibration/validation activities.

Methods & Preliminary results

- Particulate optical backscattering coefficient (470, 532, 700 nm), beam-attenuation and absorption coefficients (400–750 nm) were determined quasi-continuously from the ship's underway water following methods detailed in Dall'Olmo et al. 2009 and Dall'Olmo et al. 2017. Highly-accurate estimates of chlorophyll concentration can be obtained from the particulate absorption coefficient (Figure 1).
- *In-situ* measurements were also collected by means of a profiling package with a SBE CTD and a WETLABs ACS to determine the particulate absorption and attenuation coefficients over the upper 300 m. The package also included a Secchi disk for measuring Secchi depth and Forel-Ule visual water colour (see Figure 2 for initial processing). The profiling package was deployed once a day, simultaneously with the noon time CTD cast. During this cruise we had numerous problems with the profiling package that will require extensive data processing and may result in data loss.
- Above-water radiometric measurements were taken quasi-continuously using a Satlantic HyperSAS system. The HyperSAS optical remote-sensing system provided hyperspectral measurements of spectral water-leaving radiance and downwelling spectral irradiance, from which the above-water remote-sensing reflectance can be computed. The 136-channel HyperOCR radiance and irradiance sensors were mounted onboard the ship to simultaneously view the sea surface and sky. These data were processed daily and compared with other continuous underway data collected by the ship (see Figures 3 and 4 for examples of preliminary data processing).

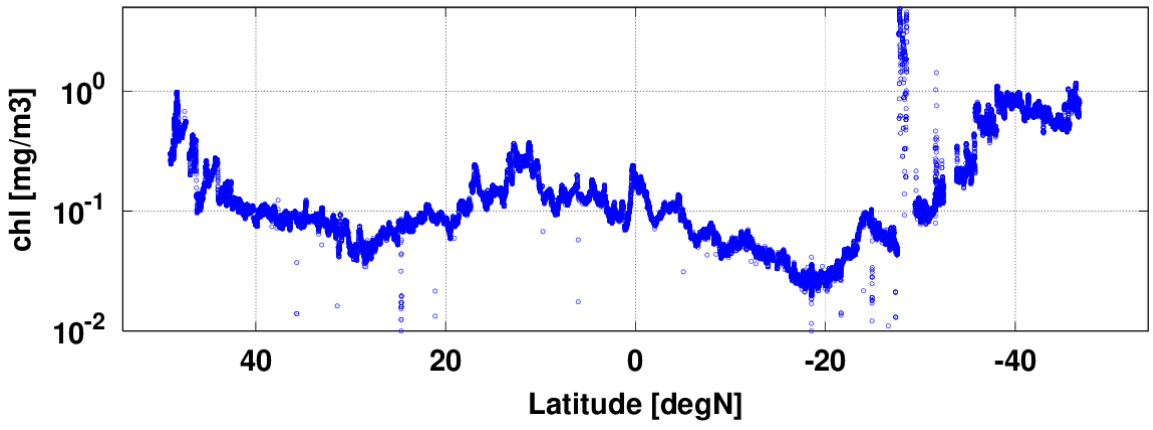

Figure 1. Preliminary surface estimates of chlorophyll concentration obtained from the underway particulate absorption measurements.

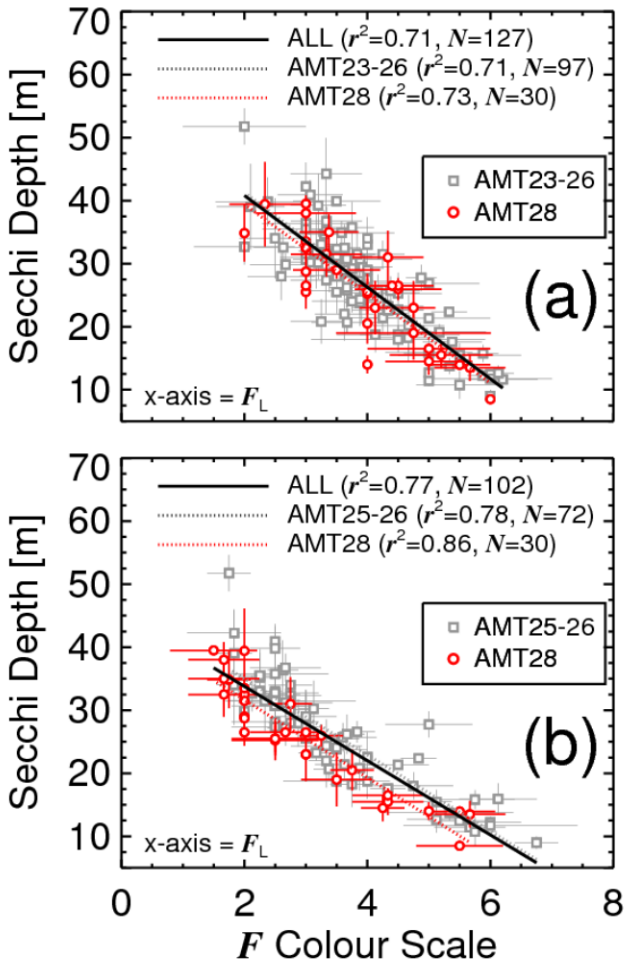

Figure 2. Secchi Depth and Forel-Ule colour measurements collected on AMT28 in red. Grey values are from previous AMT cruises (AMT23, 25 and 26).

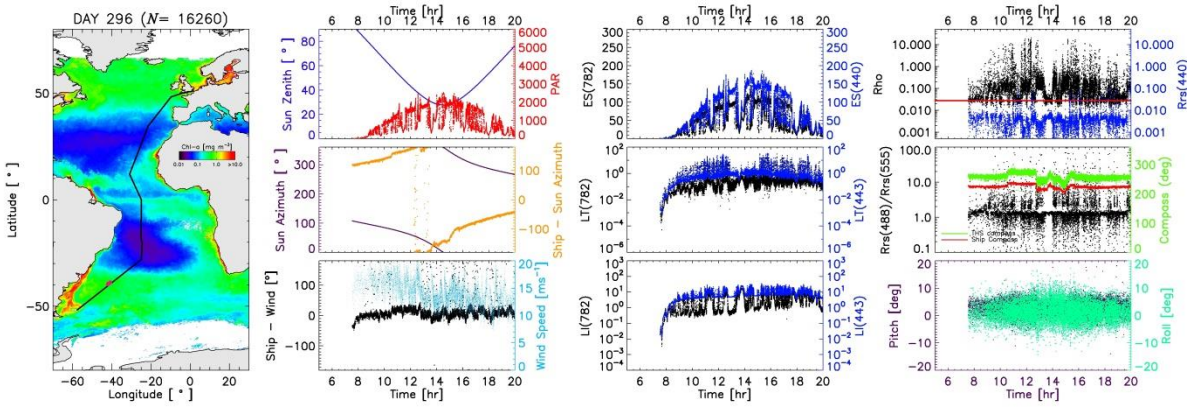

Figure 3. HyperSAS data from 23rd October 2018. This was during a very windy and rough day as we approached the Southern Ocean (see far left plot for location and far bottom right for pitch and roll of ship). All systems appeared to be working well, for example the daily time-series of Es data (spectral downwelling irradiance) was in good agreement with the ship's PAR data.

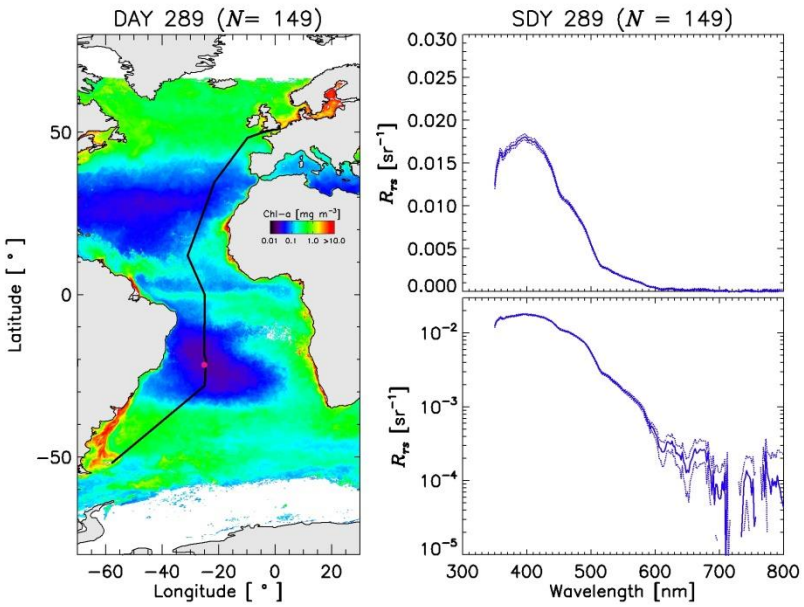

Figure 4. Remote-sensing reflectance spectra for a station in the centre of the South Atlantic Gyre during AMT28 on 16th October 2018.

References

Dall'Olmo et al. (2009) Significant contribution of large particles to optical backscattering in the open ocean. Biogeosciences, 6, 947–967.
Dall'Olmo et al. (2017) Determination of the absorption coefficient of chromophoric dissolved organic matter from underway spectrophotometry. Optics Express, https://doi.org/10.1364/OE.25.0A1079

Estimating Phytoplankton Size Distribution Using Flow Cytometry Side-scattering Measurements

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Objective

In order to derive phytoplankton size distributions from flow cytometry data, we investigated the extent to which empirical relationships could be established between the side scatter measured by flow cytometry and the cell diameter determined by a Coulter counter (Grob et al., 2007).

Methodology

1. Water samples (5-14 L) were collected from the rosette at the surface or deep chlorophyll maximum and concentrated in a 0.22 µm Sterivex filter.
2. The concentrated sample was then collected from the filter and analysed using a sorting flow cytometer (FACSort).
3. Distinctive cell populations were sorted based on their fluorescence and scattering properties. The instrument sensitivity was tuned differently for detecting picoplankton and nanoplankton populations ("pico-"and "nano-settings").

4. The sorted cells were collected and analysed in a Beckman Coulter counter (Multisizer 3) using a 20 µm aperture tube.
5. The median diameters and median side scattering of each sorted population were finally used to derive empirical relationships that could allow us to convert side-scattering data into cell diameters.

Provisional results

Similar side-scatter distributions were found between AMT26 and AMT28 (Figure 1) in both the nano- and pico-settings. For the nano-settings, it appears that the side scatter was positively correlated with cell diameter. This positive correlation was not as apparent in the pico setting.

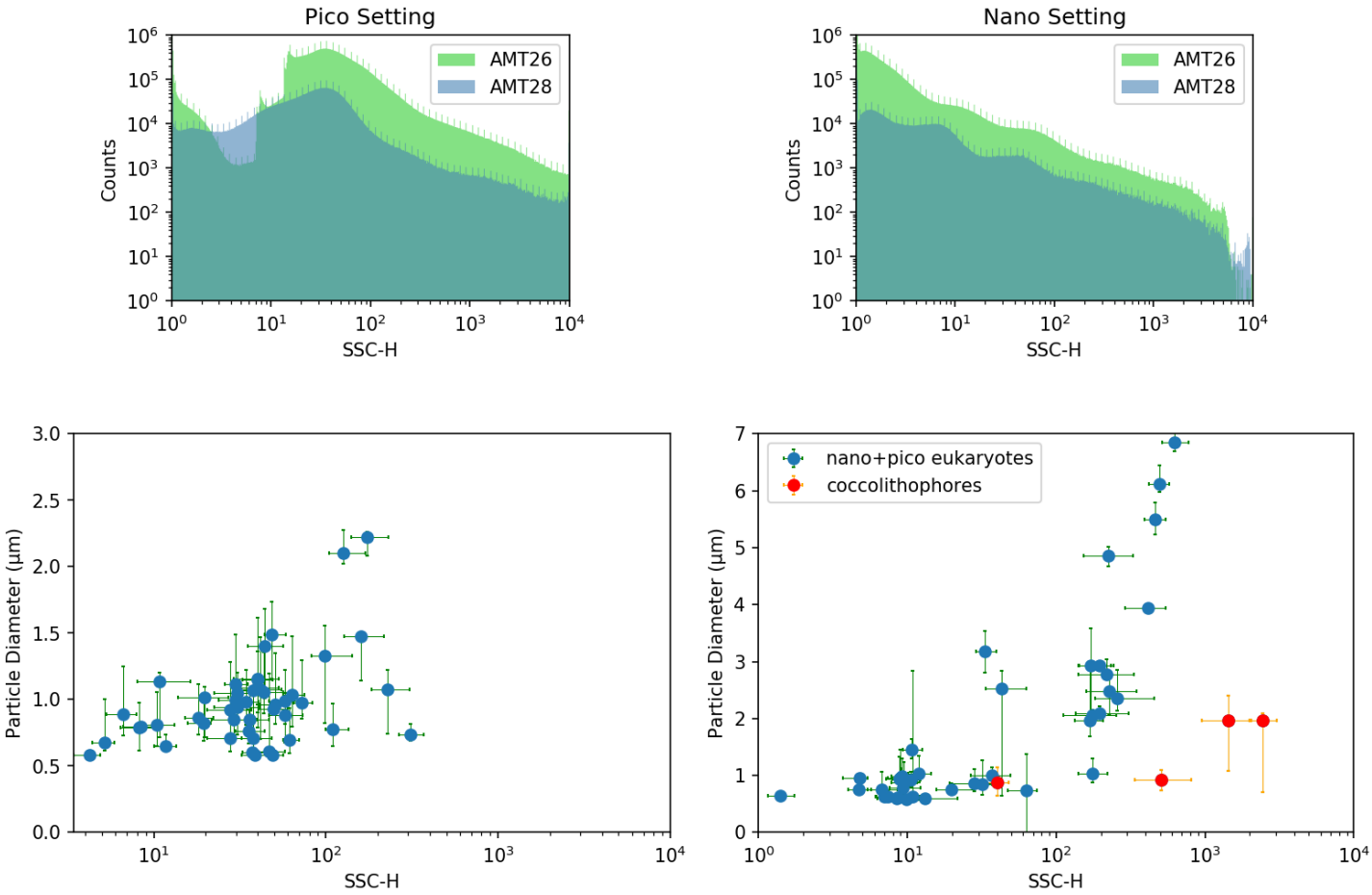

Figure 1: Distributions of side-scatter (SSC-H) for AMT26 (green) and AMT28 (blue) for pico- (left) and nano-settings (right). The scatter plots at the bottom present the relationships between side scatter and cell diameter for the sorted populations.

Table 1: CTD Samples taken for cell sorting analysis during AMT 28

CTD	Station	Date	Time	Latitude	Longitude	Depth	Niskin	Volume(L)
CTD01	STN01	2018/09/25	12:35	49° 38.287' N	05° 30.096' W	SURFACE	21	5
CTD03	STN03	2018/09/26	13:08	47° 54.075' N	10° 22.883' W	DCM	14	5
CTD05	STN05	2018/09/27	13:10	44° 58.716' N	13° 35.362' W	DCM	11	5
CTD07	STN07	2018/09/28	13:03	41° 54.700' N	16° 02.178' W	DCM	9	5
CTD09	STN09	2018/09/29	12:00	38° 37.851' N	18° 31.541' W	DCM	9	5
CTD11	STN11	2018/09/30	12:59	35° 18.121' N	20° 54.912' W	DCM	7	5
CTD13	STN13	2018/10/01	13:07	31° 55.442' N	22° 42.611 W	DCM	9	5
CTD15	STN15	2018/10/02	10:50	28° 36.544' N	24° 21.650' W	DCM	11	5
CTD17	STN17	2018/10/03	13:01	25° 03.461' N	26° 03.408' W	SURFACE	8	5
CTD19	STN19	2018/10/04	13:01	21° 26.830' N	27° 44.720' W	DCM	8,9	14
CTD21	STN21	2018/10/05	13:01	17° 44.839' N	28° 55.814' W	DCM	9,10	14
CTD23	STN23	2018/10/06	13:01	13° 48.730' N	28° 17.673' W	DCM	11,12	14
CTD25	STN25	2018/10/07	13:00	10° 05.894' N	27° 17.629' W	DCM	8,9	14
CTD27	STN28	2018/10/08	13:02	06° 15.359' N	26° 22.796' W	DCM	11,12	14
CTD30	STN31	2018/10/10	13:04	01° 09.109' S	24° 59.435' W	DCM	10,11	14
CTD32	STN33	2018/10/11	13:02	04° 59.077' S	24° 58.392' W	DCM	10,11	14
CTD34	STN35	2018/10/12	13:01	08° 45.785' S	24° 56.904' W	DCM	10	14
CTD36	STN37	2018/10/13	10:33	12° 04.969' S	24° 55.818' W	DCM	13,14	10
CTD38	STN40	2018/10/14	13:07	16° 01.942' S	25° 01.412' W	DCM	11	14
CTD41	STN44	2018/10/16	13:01	21° 36.224' S	25° 02.786' W	DCM	7	14
CTD43	STN46	2018/10/17	13:03	24° 54.350' S	25° 54.196' W	DCM	8	14
CTD45	STN48	2018/10/18	10:36	27° 12.003' S	28° 15.011' W	DCM	15	5
CTD47	STN50	2018/10/19	13:01	30° 00.355' S	31° 08.982' W	DCM	14,15	14
CTD49	STN52	2018/10/20	13:12	32° 22.371' S	33° 40.448' W	DCM	16	6
CTD53	STN56	2018/10/22	13:15	37° 00.723' S	38° 50.077' W	DCM	13,14	14
CTD59	STN62	2018/10/25	14:06	43° 47.429' S	46° 57.313' W	DCM	14	12
CTD61	STN64	2018/10/26	14:09	46° 01.052' S	49° 52.339' W	DCM	13	14

Underway Samples

Underway samples were taken on days where there were no noon CTDs. Underway samples were also taken when there were shortages in water from the CTD.

Table 2: Underway samples taken for cell sorting analysis during AMT 28

CTD	Station	Date	Time	Latitude	Longitude	Depth	Niskin	Volume(L)
UND1	Underway	2018/10/15	8:16	18° 32.560' S	25° 05.395' W	Surface	N/A	16
UND2	Underway	2018/10/21	13:25	34° 34.831' S	36° 05.487' W	Surface	N/A	25
UND3	Underway	2018/10/23	12:47	39° 12.372' S	41° 28.361' W	Surface	N/A	12
UND4	Underway	2018/10/24	12:52	41° 22.179' S	44° 00.764' W	Surface	N/A	16
UND5	Underway	2018/10/27	10:45	47° 51.198' S	52° 13.096' W	Surface	N/A	14

References

Grob, C., Ulloa, O., Claustre, H., Huot, Y., Alarcon, G. and Marie, D., 2007. Contribution of picoplankton to the total particulate organic carbon concentration in the eastern South Pacific. *Biogeosciences*, *4*(5), pp.837-852.

Dissolved Inorganic Nutrients

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UCSD - Scripps Institution of Oceanography

Objectives:

To provide dissolved nitrate, nitrite, phosphate, and silicate analysis of all CTD casts along the AMT28 transect. To provide dissolved nutrient analysis in coordination with SOCCOM float deployments for sensor calibration and contribution to a reference database.

Sampling:

Nutrient samples were drawn into 30 mL polypropylene screw-capped centrifuge tubes. The tubes and caps were cleaned with 10% HCl and rinsed 2-3 times with sample before filling. Samples were either analyzed within 1-3 hours after sample collection or stored overnight in the fridge, allowing sufficient time for all samples to reach room temperature. The centrifuge tubes fit directly onto the sampler.

Methods:

Nutrient analyses (phosphate, silicate, nitrate+nitrite, and nitrite) were performed on a Seal Analytical continuous-flow AutoAnalyzer 3 (AA3). The methods used are described by Gordon et al [Gordon1992] Hager et al. [Hager1972], and Atlas et al. [Atlas1971]. Details of the modification of analytical methods used in this cruise are also compatible with the methods described in the nutrient section of the GO-SHIP repeat hydrography manual (Hydes et al., 2010) [Hydes2010].

Nitrate/Nitrite Analysis

A modification of the Armstrong et al. (1967) [Armstrong1967] procedure was used for the analysis of nitrate and nitrite. For nitrate analysis, a seawater sample was passed through a cadmium column where the nitrate was reduced to nitrite. This nitrite was then diazotized with sulfanilamide and coupled with N-(1-naphthyl)-ethylenediamine to form a red dye. The sample was then passed through a 10 mm flowcell and absorbance measured at 540 nm. The procedure was the same for the nitrite analysis but without the cadmium column.

Phosphate Analysis

Ortho-Phosphate was analyzed using a modification of the Bernhardt and Wilhelms (1967) [Bernhardt1967] method. Acidified ammonium molybdate was added to a seawater sample to produce phosphomolybdic acid, which was then reduced to phosphomolybdous acid (a blue compound) following the addition of dihydrazine sulfate. The sample was passed through a 10 mm flowcell and absorbance measured at 820 nm.

Silicate Analysis

Silicate was analyzed using the basic method of Armstrong et al. (1967). Acidified ammonium molybdate was added to a seawater sample to produce silicomolybdic acid which was then reduced to silicomolybdous acid (a blue compound) following the addition of stannous chloride. The sample was passed through a 10 mm flowcell and absorbance measured at 660 nm.

Data Collection and Processing

Data collection and processing was done with the software ACCE (ver 6.10) provided with the instrument from Seal Analytical. After each run, the charts were reviewed for any problems during the run, any blank was subtracted, and final concentrations (micromoles per litre) were calculated, based

on a linear curve fit. Once the run was reviewed and concentrations calculated, a text file was created. That text file was reviewed for possible problems and then converted to another text file with only sample identifiers and nutrient concentrations that were merged with other bottle data.

Standards and Glassware Calibration

Primary standards for silicate (Na_2SiF_6), nitrate (KNO_3), nitrite ($NaNO_2$), and phosphate (KH_2PO_4) were obtained from Johnson Matthey Chemical Co. and/or Fisher Scientific. The supplier reports purities of >98%, 99.999%, 97%, and 99.999 respectively. All glass volumetric flasks and pipettes were gravimetrically calibrated prior to the cruise. The primary standards were dried and weighed out to 0.1 mg prior to the cruise. The exact weight was noted for future reference. When primary standards were made, the flask volume at 20 ^{o}C, the weight of the powder, and the temperature of the solution were used to buoyancy-correct the weight, calculate the exact concentration of the solution, and determine how much of the primary was needed for the desired concentrations of secondary standard. Primary and secondary standards were made up every 10-14 days. The new standards were compared to the old before use. All the reagent solutions, primary and secondary standards were made with fresh distilled deionized water (DIW). Standardizations were performed at the beginning of each group of analyses with working standards prepared every 10-12 hours from a secondary. Working standards were made up in low nutrient seawater (LNSW). One batch of LNSW was used on the cruise. It was collected and filtered prior to the cruise. The actual concentration of nutrients in this water was empirically determined during the standardization calculations.

Quality Control

All final data is reported in micromoles per kg. NO_3, PO_4, and NO_2 are reported to two decimal places and SIL to one. Accuracy is based on the quality of the standards. The levels are:

NO_3 0.05 µM (micromoles per litre)

PO_4 0.004 µM

SIL 2-4 µM

NO_2 0.05 µM

As is standard ODF practice, a deep calibration “check” sample was run with each set of samples to estimate precision within the cruise. This water was collected from station 6, Niskin 1.

Reference materials for nutrients in seawater (RMNS) were also used as a check sample run once a day. The RMNS preparation, verification, and suggested protocol for use of the material are described by [Aoyama2006], [Aoyama2007], [Aoyama2008] and Sato [Sato2010]. RMNS batch CG-1733 was used on this cruise, with each bottle being used once or twice before being discarded and a new one opened.

A total of 63 CTD casts and 925 samples were collected and analyzed for dissolved nutrients. Niskin bottles analyzed are tabulated below:

Table 1: CTD samples analysed for nutrients on AMT28

Date	Time	Station No	CTD Cast	LAT	LONG (W)	Niskin
26/09/18	334	2	2	48º 28,165'	8º 50,193'	1,3,4,6,12,13,15,17,19,20
26/09/18	1210	3	3	47º 54,073	10º 23,884	1-24
27/09/18	330	4	4	46º 01,745'	12º 43,950	1,3,4,6,12,13,15,17,19,20
27/09/18	1207	5	5	44º 58,715'	13º 35,363	2-17,20-24
28/09/18	333	6	6	42º 58,022	15º 12,784	1,2,4,5,8,13,14,18,20,21
28/09/18	1201	7	7	41º54,700'	16º02,179	1-17,19-22
29/09/18	334	8	8	39º 43,158 '	17º 42,968'	1,3,4,7,12,13,15,17,19,20
29/09/18	1200	9	9	38º 37,851'	18º 31,541'	1-17,19-24
30/09/18	436	10	10	36º 24,836'	20º 07,287'	1,3,4,7,12,13,14,16,18,19,21
30/09/18	1259	11	11	35º 18,121'	20º 54,912'	1-16,18,20-23
01/10/18	438	12	12	33º 2,816'	22º 08',206'	1,3,4,6,10,11,12,13,15,17,19,20,22
01/10/18	1307	13	13	31º 55,442' N	22º 42,611'	1-9,11-16,18,20,21,22
02/10/18	435	14	14	29º 29,299'N	23º 55,948'	1,4,5,8,13,14,15,17,19-21
02/10/18	1050	15	15	28º 36,544' N	24º 21,650'	1-8,10,13-16,18,19,22,23
03/10/18	436	16	16	26º 12,227' N	25º 31,264'	1,3,4,7,12,13,15,17,19,20,21
03/10/18	1301	17	17	25º 03,461' N	26º 03,408'	1-8,10-16,18,20,21,23
04/10/18	436	18	18	22º 35,980' N	27º 12,800'	1,4-7,9,13,14,15,17,19,20,21
04/10/18	1301	19	19	21º 26.830' N	27º 44.720'	1-8,10-21,23
05/10/18	438	20	20	19º 04,664' N	28º 49,004'	1,3,4,7,11,12,13,16,18,19,21
05/10/18	1301	21	21	17º 44,837' N	28º 55,814'	1-10,12-18,20,21,23
06/10/18	438	22	22	15º 04, 566' N	28º 36,756'	1-7,9,11,14,15,16,18,19,21,22
06/10/18	1301	23	23	13º 48,630' N	28º 17,763'	1,2,3,5,6,7,9,10,11,13-19,21,23

07/10/18	437	24	24	11º 26,819'N	27º 42,524'	1,3,4,5,8,12,13,15,17,19,21
07/10/18	1300	25	25	10º 05,894'N	27º 17,629'	1-8,10-13
08/10/18	438	27	26	07º 28,277' N	26º 39,007'	1,3,4,5,8,12,13,14,16,17,19,21
08/10/18	1302	28	27	06º 15,359' N	26º 22,796'	1-11,13-21
09/10/18	439	29	28	03º 48,465' N	25º 50,148'	1,3,4,5,8,12,13,14,15,17,19,20,21
10/10/18	446	30	29	00º 00,031' S	24º 59,953'	1,3,5,8,12,13,15,17,19,20
10/10/18	1304	31	30	01º 09,109' S	24º 59,435'	1-10,12-20
11/10/18	460	32	31	03º 41,467' S	24º 58,694'	1,3,4,5,69,14,15,17,18,20,21
11/10/18	1302	33	32	04º 59,077' S	24º 58,392'	1-10,12-20
12/10/18	439	34	33	07º 32,922' S	24º 57,444'	1,4,5,8,12,13,16,18,19,20
12/10/18	1301	35	34	08º 45,785' S	24º 56,904'	1-8,11-18,20,21
13/10/18	435	36	35	11º 15,739' S	24º 56,250'	1,3,4,7,11,12,13,14,16,17,19,20,21
13/10/18	1033	37	36	12º 04,969' S	24º 55,818'	10,11,13,13,15,16,17,19,20,23
14/10/18	435	38	37	14º 46,784' S	24º 59,086'	1,4,6,7,12,13,15,17,19,21
14/10/18	1307	40	38	16º 01,942' S	25º 01,412'	1-9,12-21
15/10/18	435	41	39	18º 20,357' S	25º 05,143'	1,3,4,5,7,11-16,18,19,21,22
16/10/18	449	43	40	20º 22,761' S	25º 03,565'	1,4,6,11,12,14,16,18,19,21
16/10/18	1301	44	41	21º 36,224' S	25º 02,786'	1-5,8,9,11-21
17/10/18	431	45	42	23º 59,974' S	24º 59,965'	1,3,4,5,8,12-15,17,18,20,21
17/10/18	1303	46	43	24º 54,350' S	25º 54,196'	1-5,7,9,10,12-18,20,21
18/10/18	443	47	44	26º 37,678' S	27º 39,321'	1,4,6,11,12,14,16,18,19,21
18/10/18	1036	48	45	27º 12,003' S	28º 15,001'	1-15,17-22
19/10/18	436	49	46	29º 07,655' S	30º 13,409'	1,3,4,7,11,12,13,14,16,17,19,20,21,24
19/10/18	1301	50	47	30º 00,355' S	31º 06,982'	1-5,7,8,9,13,16-22
20/10/18	444	51	48	31º 37,104' S	32º 53,058'	1,4,6,11,12,14,16,18,19,21
20/10/18	1312	52	49	32º 22,371' S	33º 40,448'	1-16,18,19,20,21,23
21/10/18	440	53	50	33º 49,894' S	35º 16,130'	1,3,4,5,6,9,13,14,15,16,18,20,21

21/10/18	1310	54	51	34º 34,830' S	36º 05,486'	1-17,19-22
22/10/18	445	55	52	36º 10,029' S	37º 51,980'	1,4,5,7,12,13,15,17,19,21
22/10/18	1315	56	53	37º 00,723' S	38º 50,077'	1-6,8-13,16-20
23/10/18	437	57	54	38º 35,043' S	40º 39,307'	1,3,4,5,6,7,10,11,12,13,14,15,17
23/10/18	1311	58	55	39º 12,560' S	41º 28,505'	1-19,21,22
24/10/18	441	59	56	40º 31,255' S	43º 04,973'	1,4,5,7,12,13,14,17,19,21
24/10/18	1309	60	57	41º 22,179' S	44º 00,764'	1-22
25/10/18	540	61	58	43º 00,361' S	45º 58,902'	1,3,4,5,6,7,10,14,15,17,18,20,21
25/10/18	1406	62	59	43º 47,429' S	46º 57,313'	1-9,11,13,16,17,18,19
26/10/18	538	63	60	45º 17,852' S	48º 53,785'	1,3,4,6,11,12,14,16,18,21
26/10/18	1409	64	61	46º 01,052' S	49º 52,339'	1,3-12,14,17,18,19
27/10/18	637	65	62	47º 33,709' S	51º 46,436'	1,3,4,5,7,8,11,12,14,15,17,19
27/10/18	1503	66	63	48º 11,932' S	52º 41,362'	1,2,3,4,5,7,8,9,13,16,17,18

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Carbonate System: Total Alkalinity (AT) and pH

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Cruise Objectives

Dissolved CO_2 reacts with water to form carbonic acid (H_2CO_3). H_2CO_3 dissociates to bicarbonate (HCO^{3-}) and carbonate (CO_3^{2-}) with the concomitant release of H^+, causing a reduction in pH. Total alkalinity (AT) of seawater describes the sum of all ionic charges in seawater, including HCO_3^-, CO_3^{2-}, H^+, inorganic and organic ions. Samples for the determination of AT and pHT (measured on the total scale) were collected in order to constrain the carbonate system along the cruise track. These samples are complemented by underway surface measurements of CO_2 partial pressure (pCO_2) measured with the PML, Live-pCO_2 system. These measurements will contribute to our understanding of the distribution of carbon sources and sinks in the Atlantic Ocean and the capacity of the ocean to take up anthropogenic CO_2.

Methods

Rinse 500 mL sample amber glass bottle 3 times (with sample) and fill directly from Niskin bottle. Avoid agitating the sample during filling. Place the bottle in a water bath at 25°C (nominal) and allow the sample temperature to equilibrate (30 minutes). Analyse samples immediately in a spectrophotometric pH system (PML asset number 590) using m-cresol-purple dye (Dickson et al., 2007). Whilst samples are equilibrating, run a reference spectrum using Milli-Q water and repeat on completion of sample analysis.
All calculations and corrections were applied using R-script. The pH method employed here has typical precision in the low 10^{-3} to 10^{-4} pH-unit range.

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Table 1: Cast numbers and Niskin bottle numbers for all samples collected

Date	Time	Station. No	CTD Cast	LAT	LONG (W)	Niskin Bottles	Depths Sampled (m)
25/09/2018	1235	01	01	49º 38,285' N	5º 30,096'	1; 3; 7; 10; 13; 15; 20; 21	80; 70; 50; 22; 17; 17; 12; 8; 5
26/09/2018	0334	02	02	48º 28,165' N	8º 50,193'	1; 3; 4; 6; 12; 13; 15; 17; 19; 20	140; 100; 70; 60; 50; 25; 20; 14; 10; 5
26/09/2018	1210	03	03	47º 54,073' N	10º 23,884'	1; 2; 3; 5; 6; 7; 8; 9; 10; 12; 13; 16; 17; 19; 20; 21	500; 300; 200; 150; 130; 100; 75; 60; 50; 40; 30; 25; 20; 15; 10; 5
27/09/2018	0330	04	04	46º 01,745' N	12º 43,950'	1; 3; 4; 6; 12; 13; 15; 17; 19; 20	200; 150; 70; 60; 50; 26; 20; 14; 10; 5
27/09/2018	1207	05	05	44º 58,715' N	13º 35,363'	2; 4; 6; 7; 8; 10; 11; 14; 15; 16; 17; 20; 21	300; 150; 100; 75; 50; 45; 40; 35; 30; 25; 20; 10; 5

28/09/2018	0333	06	06	42º 58,022’ N	15º 12,784’	2; 4; 5; 8; 13; 14; 15; 17; 18; 20; 21	200; 150; 60; 52; 50; 40; 23; 20; 12; 7; 5
28/09/2018	1201	07	07	41º54,700' N	16º02,179’	1; 2; 3; 4; 6 ;7; 8; 9; 12; 14; 15; 16; 17; 20; 21	500; 300; 200; 150; 100; 80; 70; 56; 50; 45; 30; 25; 20; 10; 5
29/09/2018	0334	08	08	39º 43,158’ N	17º 42,968'	1; 2; 3; 4; 6; 7; 8; 11; 12; 14; 15; 16; 17; 20; 21	500; 300, 200; 150; 100; 80; 70; 60; 50; 45; 30; 25; 20; 10; 5
29/09/2018	1200	09	09	38º 37,851' N	18º 31,541'	1; 3; 4; 7; 12; 13; 14; 16; 18; 19; 21	200; 150; 115; 105; 60; 50; 45; 25; 20; 14; 5
30/09/2018	0436	10	10	36º 24,836' N	20º 07,287'	1; 2; 3; 4; 6; 7; 10; 11; 13; 15; 16; 18; 20; 21	500; 300; 200; 150; 120; 105; 90; 75; 50; 40; 30; 20; 10; 5
30/09/2018	1259	11	11	35º 18,121' N	20º 54,912'	1; 3; 4; 6; 7; 10; 11; 13; 15; 17; 19; 20; 22	200; 150; 100; 90; 80; 60; 50; 39; 30; 22; 20; 12; 5
01/10/2018	0438	12	12	33º 2,816' N	22º 08',206'	1; 2; 3; 4; 6; 7; 8; 11; 13; 15; 16; 18; 20; 21	500; 300; 200; 150; 120; 100; 85; 75; 50; 40; 30; 20; 10; 5
01/10/2018	1307	13	13	31º 55,442' N	22º 42,611'	1; 4; 5; 8; 13; 14; 17; 18; 19; 20; 21	200; 150; 124; 114; 65; 50; 48; 28; 20; 15; 5
02/10/2018	0435	14	14	29º 29,299'N	23º 55,948'	7; 8; 10; 13; 14; 15; 16; 18; 19; 20; 5	200; 150; 135; 115; 90; 70; 50; 35, 20; 5
02/10/2018	1050	15	15	28º 36,544' N	24º 21,650'	7; 8; 10; 13; 14; 15; 16; 18; 19; 22	200; 150; 115; 90; 70; 50; 35; 20; 5
03/10/2018	0436	16	16	26º 12,227' N	25º 31,264'	1; 3; 7; 11; 12; 13; 14; 15; 17; 19; 20; 21	200; 150; 117; 107; 90; 76; 60; 50; 45; 25; 20; 14; 5
03/10/2018	1301	17	17	25º 03,461' N	26º 03,408'	1; 2; 3; 4; 5; 7; 10; 11; 13; 15; 16; 18; 20; 21	500; 300; 200; 150; 140; 120; 100; 80; 50; 40; 30; 20; 10; 5
04/10/2018	0436	18	18	22º 35,980' N	27º 12,800'	1; 4; 5; 6; 7; 9; 13; 14; 15; 17; 19; 20; 21	200; 150; 130; 120; 103; 93; 65; 50; ,41; 23; 20; 13; 5
04/10/2018	1301	19	19	21º 26.830' N	27º 44.720'	1; 2; 3; 4; 5; 10; 11; 12; 14; 16; 17; 18; 20; 21	500; 300; 200; 150; 140; 120; 105; 85; 75; 50; 40; 30; 20; 10; 5
05/10/2018	0438	20	20	19º 04,664' N	28º 49,004'	1; 3; 4; 7; 11; 12; 13; 16; 18; 19; 21	200; 150; 100; 90; 66; 50; 39; 22; 20; 12; 5
05/10/2018	1301	21	21	17º 44,837' N	28º 55,814'	1; 2; 3; 4; 5; 7; 8; 9; 12; 14; 16; 17; 18; 20; 21	500; 300; 200; 150; 115; 85; 75; 65; 60; 50; 40; 30; 20; 10; 5

06/10/2018	0438	22	22	15º 04, 566' N	28º 36,756'	1; 3;4; 5, 6; 7; 9; 11; 14; 15; 16; 18; 19; 21; 22	200; 150; 125; 100; 80; 67; 62; 57; 50; 36; 25; 20, 14; 7; 5
06/10/2018	1301	23	23	13º 48,630' N	28º 17,763'	1; 2; 3; 5; 6; 8; 9; 10; 14; 16;17; 18; 19; 20; 21	500; 300; 200; 150; 120; 85; 75; 60; 50;45; 40; 30; 20; 10; 5
07/10/2018	0437	24	24	11º 26,819'N	27º 42,524'	1; 3; 4; 5; 8; 12; 13; 15; 17; 19; 21	200; 150; 100; 60 ;50; 30; 22; 20 12; 7; 5
07/10/2018	1300	25	25	10º 05,894'N	27º 17,629'	1; 2; 3; 4; 5; 6; 7; 8; 10; 11; 12; 13; 14; 15	200; 150; 100; 70; 70; 50; 40; 40; 35; 30; 20; 5; 5; 5
08/10/2018	0438	27	26	07º 28,277' N	26º 39,007'	1; 3; 4; 5; 8; 12; 13; 14; 16; 17; 19; 21	200; 150; 100; 82; 72; 50; 40; 30; 20; 17; 9; 5
08/10/2018	1302	28	27	06º 15,359' N	26º 22,796'	1; 2; 3; 5; 6; 7; 8; 9; 10; 13; 14; 16;	500; 300; 200; 150; 120; 10; 85; 70; 64; 54; 50;45;40; 30; 20; 13; 5
09/10/2018	0439	29	28	03º 48,465' N	25º 50,148'	1; 3; 4; 5; 8; 12; 13; 14; 15; 17; 19; 20; 21	200; 150; 115; 99; 89; 80; 60; 50;39; 22; 20;12; 5
10/10/2018	0446	30	29	00º 00,031' S	24º 59,953'	1; 3; 5; 8; 12; 13; 15; 17; 19; 20	200; 150;70; 60; 50; 26; 20; 14; 8; 5
10/10/2018	1304	31	30	01º 09,109' S	24º 59,435'	1; 2; 3; 4; 5; 6; 7; 8; 9; 12; 14; 15; 16; 17; 18; 19	500; 300; 200; 150; 120; 100; 90; 82; 75; 70; 50; 40; 30; 20; 13; 5
11/10/2018	0460	32	31	03º 41,467' S	24º 58,694'	1; 3;4;5; 6, 9; 14; 15; 17; 18; 20; 21	200; 150; 90; 80; 70; 60; 50; 26; 20; 14; 8; 5
11/10/2018	1302	33	32	04º 59,077' S	24º 58,392'	1; 2; 3; 4; 5; 6; 7; 8; 9; 12; 14; 15; 16; 17; 19	500; 300; 200; 150; 125; 100; 90; 80; 74; 70; 50; 40; 30; 20; 5
12/10/2018	0439	34	33	07º 32,922' S	24º 57,444'	1; 4;5; 8; 12; 13; 16; 18; 19; 20	200; 150; 120; 110; 50; 47 ;26; 20; 15; 5
12/10/2018	1301	35	34	08º 45,785' S	24º 56,904'	1; 2; 3; 4; 5; 6; 7; 11; 12; 13; 15; 16; 17; 18; 19; 20	500; 300; 200; 175; 150; 135; 120; 110; 90; 70; 50; 40; 30; 20; 13; 5
13/10/2018	0435	36	35	11º 15,739' S	24º 56,250'	1; 3; 4; 7; 11 ;12; 13; 14; 16; 17; 19; 20; 21	200; 150; 132; 122; 110; 100; 80; 53; 50; 30; 20; 16; 5
13/10/2018	1033	37	36	12º 04,969' S	24º 55,818'	10; 11; 13; 15; 16; 17; 19; 20; 23	200; 150; 111; 100; 70; 50; 35; 20; 5
14/10/2018	0435	38	37	14º 46,784' S	24º 59,086'	1; 4; 6; 7; 12; 13; 15; 17; 19; 21	200; 155; 150; 145; 100; 62; 55; 35; 20; 5

14/10/2018	1307	40	38	16º 01,942' S	25º 01,412'	1; 2; 3; 4; 5; 6; 8; 12; 14; 15; 16; 17; 18; 19; 20	500; 300; 250; 200; 185; 175; 160; 150; 120; 100; 75; 50; 40; 20; 5
15/10/2018	0435	41	39	18º 20,357' S	25º 05,143'	1; 3, 4; 5; 7; 11; 12; 13; 14; 15; 16; 18; 19; 21; 22	200; 185; 175; 162; 152; 140; 130; 120; 100; 80; 65; 50; 36; 20; 5
16/10/2018	0449	43	40	20º 22,761' S	25º 03,565'	1; 4; 6; 11; 12; 14; 16; 18; 19; 21	200; 171; 161; ,100; 70; 50; 40; 25; 20; 5
16/10/2018	1301	44	41	21º 36,224' S	25º 02,786'	1; 2; 5; 8; 12; 13; 14; 15; 16; 17; 18; 19; 20	500; 300; 185; 170; 150; 125; 100; 85; 70; 50; 35; 20; 5
17/10/2018	0431	45	42	23º 59,974' S	24º 59,965'	1; 3; 4; 5; 8; 12; 13; 14; 15; 17; 18; 20; 21	200; 180; 160; 150; 140; 120; 100; 80; 60; 50; 34; 20; 5
17/10/2018	1303	46	43	24º 54,350' S	25º 54,196'	1; 2; 3; 4; 5; 9; 12; 13; 14; 15; 16; 17; 18; 19; 20	500; 300; 250; 200; 180; 140; 125; 110; 95; 85; 70; 50; 35; 20; 5
18/10/2018	0443	47	44	26º 37,678' S	27º 39,321'	1; 4; 6; 11; 12; 14; 16; 18; 19; 21	200; 137; 127; 100; 56; 50; 30; 20; 17; 5
18/10/2018	1036	48	45	27º 12,003' S	28º 15,001'	1; 3; 6; 9; 11; 12; 13; 14; 15; 17; 18; 19; 20; 21; 22	1500; 1300; 1000; 700; 500; 400; 300; 200; 140; 100; 75; 60; 50; 25; 5
19/10/2018	0436	49	46	29º 07,655' S	30º 13,409'	1; 3; 4; 7; 11; 12; 13; 14; 16; 17; 19; 20; 21	200; 150; 140; 130; 110; 90; 70; 56; 50; 31; 20; 17; 5
19/10/2018	1301	50	47	30º 00,355' S	31º 06,982'	1; 2; 3; 4; 5; 7; 9; 13; 16; 17; 18; 19; 20; 21; 22	500; 300; 250; 200; 180; 150; 119; 109; 100; 85; 70; 50; 35; 20; 5
20/10/2018	0444	51	48	31º 37,104' S	32º 53,058'	1; 4; 6; 11; 12; 14; 16;18; 19; 21; 24	200; 141; 131; 100; 56; 50; 31; 20; 17; 5
20/10/2018	1312	52	49	32º 22,371' S	33º 40,448'	1; 3; 6; 9; 11; 12; 13; 14; 15; 16; 18; 19; 20; 21; 22	1500; 1300; 1000; 700; 500; 400; 300; 200; 150; 85; 75; 60; 50; 25; 5
21/10/2018	0440	53	50	33º 49,894' S	35º 16,130'	1; 3; 4; 5; 6; 9; 13; 14; 15; 16; 18; 20; 21	200; 150; 125; 100; 90; 80; 70; 60; 50; 34; 20; 11; 5
21/10/2018	1310	54	51	34º 34,830' S	36º 05,486'	2; 3; 5; 9; 12; 13; 14; 15; 16; 17; 19; 20; 21; 22	1400; 1300; 1100; 700; 400; 300; 200; 150; 100; 70; 65; 50; 25; 5

22/10/2018	0445	55	52	36º 10,029' S	37º 51,980'	1; 4; 5; 7; 12; 13; 15; 17; 19; 21; 24	200; 130; 80; 70; 50; 30; 20; 17; 10; 5
22/10/2018	1315	56	53	37º 00,723' S	38º 50,077'	1; 2; 3; 4; 6; 8; 9; 10; 11; 12; 13; 16; 17; 18; 20	500; 300; 200; 150; 120; 100; 85; 70; 60; 50; 40; 30; 20; 15; 5
23/10/2018	0437	57	54	38º 35,043' S	40º 39,307'	1; 3; 4; 5; 6; 7; 10; 11; 12; 13; 14; 15; 17; 18	200; 150; 125; 100; 75; 65; 50; 40; 28; 20; 16; 9; 7
23/10/2018	1311	58	55	39º 12,560' S	41º 28,505'	2; 4; 6; 9; 12; 13; 14; 15; 16; 17; 18; 19; 21; 22	1400; 1200; 1000; 700; 400; 300; 200; 150; 100; 75; 50; 30; 15; 8
24/10/2018	0441	59	56	40º 31,255' S	43º 04,973'	1; 4; 5; 7; 12; 13; 14; 17; 19; 21	200; 100; 50; 40; 35; 20; 17; 10; 8; 5
24/10/2018	1309	60	57	41º 22,179' S	44º 00,764'	2; 4; 6; 9; 12; 13; 14; 15; 16; 17; 18; 19; 21; 22	1400; 1200; 1000; 700; 400; 300; 200; 150; 100; 75; 50; 35; 20; 5
25/10/2018	0540	61	58	43º 00,361' S	45º 58,902'	1; 3; 4; 5; 6; 7; 10; 14; 15; 17; 18; 20; 21	200; 140; 120; 100; 80; 65; 55; 50; 24; 20; 13; 7; 5
25/10/2018	1406	62	59	43º 47,429' S	46º 57,313'	1; 2; 3; 4; 6; 7; 8; 9; 11; 13; 16; 17; 18; 19	500; 300; 200; 150; 120; 100; 85; 70; 50; 38; 30; 20; 15; 5
26/10/2018	0538	63	60	45º 17,852' S	48º 53,785'	1; 3; 4; 6; 11; 12; 14; 16; 18; 21	200; 100; 63; 53; 50; 24; 20; 13; 7; 5
26/10/2018	1409	64	61	46º 01,052' S	49º 52,339'	1; 2; 3; 4; 6; 7; 8; 9; 11; 12; 14; 15; 17; 19	500; 300; 200; 150; 120; 100; 85; 70; 50; 40; 30; 20; 15; 5
27/10/2018	0637	65	62	47º 33,709' S	51º 46,436'	1; 3; 4; 5; 7; 8; 11; 12; 14; 15; 17; 19	200; 150; 125; 100; 76; 66; 50; 28; 20; 16; 10; 5
27/10/2018	1503	66	63	48º 11,932' S	52º 41,362'	1; 2; 3; 4; 5; 7; 8; 13; 16; 18	500; 300; 200; 150; 135; 100; 80; 40; 30; 5

Salinity Sample Collection and Analysis

Arwen Bargery
British Oceanographic Data Centre

Cruise Objectives

Collection of CTD and underway seawater samples for salinity analysis and subsequent calibration of the TSG and CTD underway sensors.

Methods

Samples were collected for salinity analysis from both CTD Niskin bottles and the ship's non-toxic underway supply. CTD samples were collected from each pre-dawn and noon CTD cast from five depths, generally collected from around 500 m, 300 m, 150 m, 20 m and 5 m depths from the noon cast, and 200 m or less from the pre-dawn cast.

Samples from the ship's underway supply were collected throughout the cruise. Samples were taken four times each day at approximately 0800, 1200, 1600 and 2000 ship time. In total, 311 CTD samples from 61 CTD casts and 168 underway samples were collected during the cruise. Samples were collected into 130 mL glass bottles pre-labelled with crate number and bottle number, with different crates for underway and CTD samples. Each bottle was filled to the shoulder with water and dried before inserting a plastic stopper and replacing the screw cap. Samples were then stored in the temperature-controlled laboratory for at least 24 hours before analysis on the salinometer.

Two Autosals were used during the cruise which belonged to the British Antarctic Survey. Initially s/n 68533 was used and this was replaced with s/n 65763 as air bubbles were identified in the cell of the former. The instrument used was a Guildline Autosal 8400B salinometer.

From the outset of the cruise there were temperature stability issues within the lab in which the Autosal was situated. To ensure greatest data accuracy, operating guidelines recommend a room temperature of +/-1 degC to which the bath temperature is set with a maximum range of -4/+2 degC. There was difficulty getting the room temperature to stabilise whilst going through the tropics due to fluctuations of the ship's air-conditioning system and additionally the room was used as access between labs. On leaving the tropics the room temperature stabilised at 20 deg C and the cell temperature of the salinometer cell temperature was set at 21 deg C with the temperature of the water samples at 19 deg C.

A standardisation of the Autosal against Standard Seawater P162 (K15=0.99983) was completed for both salinometers prior to analysis of samples and the Autosals were left to stabilise for at least 24 hours after setting the cell temperature.

Table 1: Table showing CTD samples collected for salinity analysis during the cruise.

Date and Time	CTD	Station	Lat (+ve N)	Lon (+ve E)	Niskin Bottles	Depths
25/09/2018 12:35	CTD001	1	49.64	-5.50	1, 16, 21, 4, 6	80, 12, 5, 70, 50
26/09/2018 03:34	CTD002	2	48.47	-8.84	3, 15, 23, 4, 10	100, 20, 5, 70, 60
26/09/2018 12:10	CTD003	3	47.90	-10.38	1, 2, 5, 10, 21	500, 300, 150, 50, 5
27/09/2018 03:30	CTD004	4	46.03	-12.73	1, 3, 12, 15, 23	200, 150, 50, 20, 5
27/09/2018 12:07	CTD005	5	44.98	-13.59	2, 4, 5, 8, 21	300, 150, 125, 50, 5
28/09/2018 03:33	CTD006	6	42.97	-15.21	2, 4, 8, 17, 24	200, 150, 52, 20, 5
28/09/2018 12:01	CTD007	7	41.91	-16.04	1, 2, 4, 12, 21	500, 30, 150, 50, 5
29/09/2018 03:34	CTD008	8	39.72	-17.72	1, 3, 8, 15, 19	200, 150, 71, 20, 9
29/09/2018 12:00	CTD009	9	38.63	-18.53	1, 2, 4, 12, 21	500, 300, 150, 50, 5

30/09/2018 04:34	CTD010	10	36.41	-20.12	1, 3, 12, 18, 24	200, 150, 60, 20, 5
30/09/2018 12:59	CTD011	11	35.30	-20.92	1, 2, 4, 13, 21	500, 300, 150, 50, 5
01/10/2018 04:38	CTD012	12	33.05	-22.14	1, 3, 6, 19, 24	200, 150, 90, 20, 5
01/10/2018 13:07	CTD013	13	31.92	-22.71	1, 2, 4, 13, 21	500, 300, 150, 50, 5
02/10/2018 04:37	CTD014	14	29.49	-23.93	1, 4, 11, 19, 24	200, 150, 14, 20, 24
02/10/2018 10:50	CTD015	15	28.61	-24.36	7, 10, 13, 16, 22	200, 135, 115, 50, 5
03/10/2018 04:37	CTD016	16	26.20	-25.52	3, 6, 7, 19, 24	150, 117, 107, 20, 5
03/10/2018 13:01	CTD017	17	25.06	-26.06	1, 2, 4, 10, 21	500, 300, 150, 100, 5
04/10/2018 04:27	CTD018	18	22.60	-27.21	1, 4, 9, 19, 24	200, 150, 93, 20, 5
04/10/2018 13:01	CTD019	19	21.45	-27.75	1, 2, 4, 10, 21	500, 300, 150, 105, 5
05/10/2018 04:38	CTD020	20	19.08	-28.82	1, 3, 10, 19, 24	200, 150, 90, 12, 5
05/10/2018 13:01	CTD021	21	17.75	-28.93	1, 2, 4, 12, 21	500, 300, 150, 60, 5
06/10/2018 04:38	CTD022	22	15.08	-28.61	1, 3, 11, 18, 24	200, 150, 57, 29, 5
06/10/2018 13:01	CTD023	23	13.81	-28.29	1, 2, 5, 10, 21	500, 300, 150, 60, 5
07/10/2018 04:37	CTD024	24	11.45	-27.71	4, 3, 5, 15, 24	150, 100, 60, 20, 5
07/10/2018 13:00	CTD025	25	10.10	-27.29	1, 2, 3, 10, 13	200, 150, 100, 35, 5
08/10/2018 04:38	CTD026	27	7.47	-26.65	1, 3, 5, 16, 24	200, 150, 82, 20, 5
08/10/2018 13:02	CTD027	28	6.26	-26.38	1, 2, 5, 10, 21	500, 300, 150, 64, 5
09/10/2018 04:39	CTD028	29	3.81	-25.84	1, 3, 8, 19, 23	200, 150, 89, 20, 5
10/10/2018 04:46	CTD029	30	0.00	-25.00	1, 3, 13, 15, 17	200, 150, 26, 20, 14
10/10/2018 13:04	CTD030	31	-1.15	-24.99	1, 2, 4, 9, 19	500, 300, 150, 75, 5
11/10/2018 04:30	CTD031	32	-3.69	-24.98	1, 3, 9, 17, 24	200, 150, 60, 20, 5
11/10/2018 13:02	CTD032	33	-4.98	-24.97	1, 2, 4, 9, 19	500, 300, 150, 74, 5
12/10/2018 04:39	CTD033	34	-7.55	-24.96	1, 4, 8, 18, 24	200, 150, 110, 20, 5
12/10/2018 13:01	CTD034	35	-8.76	-24.95	1, 2, 5, 11, 20	500, 300, 150, 110, 5
13/10/2018 04:35	CTD035	36	-11.26	-24.94	1, 3, 7, 19, 24	200, 150, 122, 20, 5
13/10/2018 10:33	CTD036	37	-12.08	-24.93	10, 13, 15, 17, 23	200, 111, 100, 50, 5
14/10/2018 04:35	CTD037	38	-14.78	-24.98	1, 4, 6, 19, 12	200, 155, 150, 100, 20
14/10/2018 13:07	CTD038	40	-16.03	-25.02	1, 2, 6, 12, 20	500, 300, 175, 150, 5
15/10/2018 04:35	CTD039	41	-18.34	-25.09	1, 4, 7, 21, 24	200, 175, 152, 20, 5
16/10/2018 04:39	CTD040	43	-20.38	-25.06	1, 4, 3, 18, 24	200, 171, 200, 25, 5
16/10/2018 13:01	CTD041	44	-21.60	-25.05	1, 2, 12, 14, 20	500, 300, 150, 100, 5
17/10/2018 04:31	CTD042	45	-24.00	-25.00	1, 5, 8, 20, 24	200, 150, 140, 20, 5
17/10/2018 13:03	CTD043	46	-24.91	-25.90	1, 2, 5, 13, 20	500, 300, 180, 110, 5
18/10/2018 04:43	CTD044	47	-26.63	-27.66	1, 4, 6, 19, 24	200, 137, 127, 17, 5
18/10/2018 10:36	CTD045	48	-27.20	-28.25	1, 6, 11, 17, 23	1500, 1000, 500, 100, 5
19/10/2018 04:36	CTD046	49	-29.13	-30.22	9, 4, 7, 20, 24	130, 140, 130, 17, 5
19/10/2018 13:01	CTD047	50	-30.01	-31.15	1, 2, 7, 16, 22	500, 300, 150, 100, 5
20/10/2018 04:45	CTD048	51	-31.62	-32.88	1, 3, 11, 19, 24	200, 200, 100, 17, 5
20/10/2018 13:12	CTD049	52	-32.37	-33.67	1, 6, 11, 15, 2	1500, 1000, 500, 150, 1400
21/10/2018 04:40	CTD050	53	-33.83	-35.27	1, 6, 3, 20, 24	200, 90, 150, 11, 5
21/10/2018 13:10	CTD051	54	-34.58	-36.09	1, 6, 11, 15, 3	1500, 1000, 500, 150, 1300
22/10/2018 04:45	CTD052	55	-36.17	-37.87	1, 5, 7, 19, 12	200, 80, 70, 10, 50

22/10/2018 13:15	CTD053	56	-37.01	-38.83	1, 2, 4, 8, 20	500, 300, 150, 100, 5
23/10/2018 04:37	CTD054	57	-38.58	-40.66	1, 3, 6, 15, 18	200, 150, 75, 9, 7
23/10/2018 13:11	CTD055	58	-39.21	-41.48	1, 6, 8, 10, 11	1500, 1000, 800, 600, 500
24/10/2018 04:41	CTD056	59	-40.52	-43.08	1, 4, 10, 12, 14	200, 100, 40, 35, 17
24/10/2018 13:09	CTD057	60	-41.37	-44.01	1, 3, 6, 11, 15	1500, 1300, 1000, 500, 150
25/10/2018 05:40	CTD058	61	-43.01	-45.98	1, 4, 5, 6, 10	200, 120, 100, 80, 55
25/10/2018 14:06	CTD059	62	-43.79	-46.96	1, 2, 4,7, 21	500, 300, 150, 100, 5
26/10/2018 05:38	CTD060	63	-45.30	-48.90	1,3, 4, 8, 11	200, 100, 63, 53, 50
26/10/2018 14:09	CTD061	64	-46.02	-49.87	1, 2, 3, 4, 6, 7, 19	500, 300, 200, 150, 120, 100, 5

Table 2: Table showing underway sample log for salinity samples collected during the cruise.

Date and Time (UT)	Julian Day	Lat (+ve N)	Lon (+ve E)	Salin-ity crate	Salinity bottle	Bench salinity reading	Flow rate (litre/min)	TSG Salinity (PSU)	Temp1 (degC)	Trans (volts)	Chlor (ug/l)	Comments
23/09/2018 11:33	266	51.8411	1.5813									Oceanlogger system switched on after departure from Harwich
25/09/2018 11:41	268	49.6756	-5.4176	U2	1	35.1985	0.5141		14.7740			Ship time is GMT + 1 hour (BST)
25/09/2018 17:39	268	49.3053	-6.4879	U2	2	35.1201	0.5980	35.1191	16.2595			Broken conductivity sensor was replaced
25/09/2018 18:57	268	49.1884	-6.7788	U2	3	35.1563	0.5869	35.1358	16.5227			
26/09/2018 08:39	269	48.1267	-9.8068	U2	4	35.5938	0.5540	35.5942	16.8545			
26/09/2018 13:55	269	47.8754	-10.4301	U2	5	35.5863	0.5579	35.5916	16.9222			
26/09/2018 15:35	269	47.7376	-10.8439	U2	6	35.6109	0.5524	35.6021	16.8774			
27/09/2018 04:59	270	45.9509	-12.8039	U2	7	35.7270	0.5022	35.7215	18.9525			
27/09/2018 06:01	270	45.7860	-12.9392	U2	8	35.7211	0.5090	35.7256	19.3042			
27/09/2018 10:16	270	45.2244	-13.4054	U2	9	35.7404	0.5058	35.7383	18.9091			
27/09/2018 13:40	270	44.9179	-13.6307	U2	10	35.7584	0.5063	35.7585	19.1921			
27/09/2018 15:00	270	44.7142	-13.8162	U2	11	35.7402	0.5059	35.7422	19.1352			
27/09/2018 17:57	270	44.2357	-14.2055	U2	12	35.6828	0.4966	35.6836	18.5950			
28/09/2018 05:11	271	42.8789	-15.2844	U2	13	35.8009	0.5108	35.8037	20.0820			

28/09/2018 08:02	271	42.4414	-15.6265	U2	14	35.9259	0.5219	35.9256	20.7167			
28/09/2018 08:04	271	42.4364	-15.6306	U2	15	35.9321	0.5224	35.9309	20.7237			
28/09/2018 09:22	271	42.2388	-15.7821	U2	16	35.8441	0.5167	35.8434	20.6477			
28/09/2018 09:24	271	42.2337	-15.7860	U2	17	35.8562	0.5174	35.8533	20.6600			
28/09/2018 10:29	271	42.1045	-15.8834	U2	18	35.8748	0.5187	35.8754	20.6695			
28/09/2018 10:31	271	42.1036	-15.8825	U2	19	35.8744	0.5158	35.8759	20.6668			
28/09/2018 11:55	271	41.9117	-16.0363	U2	20	35.8803	0.5213	35.8816	20.7156			
28/09/2018 11:57	271	41.9117	-16.0363	U2	21	35.8809	0.5194	35.8817	20.7170			
28/09/2018 13:39	271	41.8171	-16.1104	U2	22	35.9427	0.5253	35.9439	20.9428			
28/09/2018 13:40	271	41.8144	-16.1124	U2	23	35.9346	0.5235	35.9401	20.9459			
28/09/2018 15:02	271	41.6012	-16.2799	U2	24	35.9516	0.5071	35.9525	20.9448			
28/09/2018 07:45	271	42.4845	-15.5919	U3	1	35.8712	0.5157	35.8713	20.6246			
28/09/2018 07:48	271	42.4768	-15.5979	U3	2	35.8807	0.5183	35.8820	20.6337			
28/09/2018 07:49	271	42.4743	-15.5999	U3	3	35.8833	0.5182	35.8835	20.6335			
28/09/2018 07:51	271	42.4692	-15.6038	U3	4	35.8848	0.5177	35.8860	20.6327			
28/09/2018 07:53	271	42.4642	-15.6079	U3	5	35.8852	0.5176	35.8866	20.6427			
28/09/2018 07:57	271	42.4541	-15.6162	U3	6	35.9048	0.5173	35.9027	20.6962			
28/09/2018 09:27	271	42.2259	-15.7919	U3	7	35.8692	0.5161	35.8696	20.6761			
28/09/2018 09:28	271	42.2233	-15.7938	U3	8	35.8744	0.5177	35.8738	20.6773			
28/09/2018 09:31	271	42.2156	-15.7997	U3	9	35.8748	0.5159	35.8770	20.6802			
28/09/2018 10:22	271	42.1069	-15.8836	U3	10	35.8714	0.5203	35.8728	20.6646			

28/09/2018 10:24	271	42.1063	-15.8834	U3	11	35.8716	0.5201	35.8736	20.6651			
28/09/2018 10:26	271	42.1057	-15.8833	U3	12	35.8734	0.5206	35.8745	20.6663			
28/09/2018 11:59	271	41.9117	-16.0363	U3	13	35.8801	0.5191	35.8816	20.7177			
28/09/2018 12:00	271	41.9117	-16.0363	U3	14	35.8807	0.5215	35.8817	20.7178			
28/09/2018 12:02	271	41.9117	-16.0363	U3	15	35.8813	0.5239	35.8815	20.7191			
28/09/2018 13:35	271	41.8279	-16.1028	U3	16	35.9394	0.5227	35.9396	20.9389			
28/09/2018 13:37	271	41.8225	-16.1065	U3	17	35.9439	0.5221	35.9432	20.9490			
28/09/2018 17:53	271	41.1565	-16.6211	U3	18	36.1381	0.5057	36.1428	21.6245			
28/09/2018 17:56	271	41.1487	-16.6271	U3	19	36.1246	0.5058	36.1269	21.5856			
28/09/2018 17:57	271	41.1461	-16.6291	U3	20	36.1128	0.5104	36.1167	21.5764			
29/09/2018 05:09	272	39.6183	-17.7851	U3	21	36.0782	0.5198	36.0793	21.9119			
29/09/2018 05:12	272	39.6105	-17.7908	U3	22	36.0831	0.5181	36.0822	21.9195			
29/09/2018 07:54	272	39.2078	-18.0977	U3	23	36.2030	0.5534	36.2039	22.2964			
29/09/2018 08:07	272	39.1744	-18.1223	U3	24	36.2050	0.5594	36.2060	22.3158			
29/09/2018 10:51	272	38.7653	-18.4225	U4	1	36.3104	0.5531	36.3138	22.6663			
29/09/2018 14:14	272	38.4697	-18.6440	U4	2	36.4151	0.5546	36.4206	22.9573			
29/09/2018 15:24	272	38.2981	-18.7581	U4	3	36.4294	0.5558	36.4401	23.0085			
29/09/2018 17:54	272	37.9406	-19.0252	U4	4	36.3288	0.5512	36.3204	23.1744			
30/09/2018 08:04	273	36.0298	-20.4050	U4	5	36.5779	0.5537	36.5788	23.2769			Ships time back 1 hour to GMT on 30/09/2018.
30/09/2018 11:02	273	35.5739	-20.7280	U4	6	36.6855	0.5936	36.6886	23.3993			

30/09/2018 15:35	273	35.0731	-21.0720	U4	7	36.6813	0.5914	36.6839	23.9070			
30/09/2018 17:50	273	34.7199	-21.2740	U4	8	36.7886	0.5933	36.4285	23.6480			
01/10/2018 07:05	274	32.8381	-22.2499	U4	9	36.6936	0.5869	36.7011	24.3915			
01/10/2018 09:05	274	32.5263	-22.4088	U4	10	36.6557	0.5891	36.6401	24.1910			
01/10/2018 14:56	274	31.8313	-22.7381	U4	11	36.7669	0.5798	36.7683	24.3469			Transmittance and flruorometer sensors were wrong way round.
01/10/2018 16:56	274	31.5072	-22.9344	U4	12	36.9096	0.5782	36.9137	24.3752			Transmissometer and fluorometer fixed on 01/10/2018 19:40
01/10/2018 20:22	274	30.9174	-23.2224	U4	13	36.9390	0.7157	36.9362	24.3384	0.8609	0.0996	
02/10/2018 06:22	275	29.3537	-23.9978	U4	14	37.0379	0.7429	37.0345	24.7918	0.8626	0.0499	
02/10/2018 08:01	275	29.0586	-24.1426	U4	15	37.4066	0.7158	37.4031	24.9492	0.8621	0.0971	
02/10/2018 11:06	275	28.6090	-24.3609	U4	16	37.4168	0.7315	37.4139	25.5337	0.8638	0.0436	
02/10/2018 14:21	275	28.5303	-24.3960	U4	17	37.3994	0.7122	37.3957	25.2916	0.8639	0.0282	
02/10/2018 15:30	275	28.3364	-24.4884	U4	18	37.2649	0.7116	37.4172	25.6740	0.8626	0.0309	
02/10/2018 19:48	275	27.6743	-24.8165	U4	19	37.2656	0.7157	37.2667	25.8150	0.8593	0.0584	
03/10/2018 05:26	276	26.2038	-25.5211	U4	20	37.2632	0.7229	37.2674	25.1468	0.8608	0.0802	
03/10/2018 08:14	276	25.7222	-25.7487	U4	21	37.2497	0.7268	37.2429	25.1983	0.8612	0.0857	
03/10/2018 13:46	276	25.0577	-26.0568	U4	22	37.3435	0.6786	37.3413	25.8196	0.8622	0.0447	
04/10/2018 06:23	277	22.4769	-27.2651	U4	23	37.0670	0.6687	37.1338	25.7257	0.8617	0.0686	

04/10/2018 06:25	277	22.4715	-27.2680	U4	24	37.0362	0.6718	37.0936	25.6477	0.8616	0.0814	
04/10/2018 08:07	277	22.1941	-27.4031	U2	1	37.0616	0.6696	37.0577	25.7633	0.8622	0.0902	
04/10/2018 13:42	277	21.4472	-27.7453	U2	2	37.0906	0.6659	37.0914	26.0723	0.8607	0.0644	
04/10/2018 15:51	277	21.1459	-27.8808	U2	3	36.8754	0.7299	36.8973	26.1878	0.8609	0.0516	
04/10/2018 17:07	277	20.9315	-27.9846	U2	4	36.6375	0.7630	36.6548	26.3363	0.8606	0.0499	
04/10/2018 19:43	277	20.5018	-28.1810	U2	5	36.5769	0.7658	36.5820	26.3820	0.8608	0.0787	
05/10/2018 06:17	278	18.9982	-28.8176	U2	6	36.8020	0.7640	36.8061	26.2292	0.8615	0.0759	
05/10/2018 07:58	278	18.7069	-28.8489	U2	7	36.6929	0.7550	36.7126	26.4600	0.8629	0.0556	
05/10/2018 11:55	278	17.9234	-28.9188	U2	8	36.4880	0.7616	36.4918	26.5568	0.8610	0.0450	
05/10/2018 15:58	278	17.3861	-28.9968	U2	9	36.5486	0.7545	36.5215	26.9696	0.8609	0.0417	
05/10/2018 19:51	278	16.6555	-28.9686	U2	10	36.3693	0.7122	36.3718	27.1234	0.8533	0.1373	
06/10/2018 05:05	279	15.0761	-28.6126	U2	11	36.3214	0.7151	36.3242	27.0825	0.8571	0.1164	
06/10/2018 07:59	279	14.6806	-28.5210	U2	12	36.3397	0.7182	36.3431	27.2682	0.8579	0.0940	
06/10/2018 11:57	279	13.9633	-28.3395	U2	13	36.3342	0.7099	36.3431	27.5525	0.8592	0.0324	
06/10/2018 16:24	279	13.3723	-28.1923	U2	14	36.0636	0.7103	36.0694	28.3907	0.8451	0.0883	
06/10/2018 20:30	279	12.6121	-28.0005	U2	15	36.0559	0.7242	36.0470	28.2557	0.8341	0.2105	
07/10/2018 06:08	280	11.3457	-27.6811	U2	16	35.8788	0.7451	35.8810	28.2084	0.8454	0.1102	
07/10/2018 08:00	280	11.0054	-27.5980	U2	17	35.8097	0.7286	35.8107	28.2258	0.8458	0.1425	
07/10/2018 11:04	280	10.4303	-27.4085	U2	18	35.9887	0.7260	35.9895	28.4477	0.8451	0.0730	
07/10/2018 12:54	280	10.0983	-27.2939	U2	19	35.9051	0.7302	35.9057	28.7398	0.8486	0.0326	
07/10/2018 15:40	280	9.6893	-27.1731	U2	20	35.8442	0.7233	35.8504	28.7917	0.8480	0.0425	

07/10/2018 20:01	280	8.8686	-26.9638	U2	21	35.3798	0.7265	35.3796	28.6450	0.8443	0.0698	
08/10/2018 07:59	281	7.0923	-26.5582	U2	22	34.8784	0.7371	34.8847	28.9103	0.8445	0.0703	
08/10/2018 12:39	281	6.2805	-26.3814	U2	23	34.9181	0.7091	34.9219	28.7110	0.8448	0.0794	
08/10/2018 16:04	281	5.9145	-26.2960	U2	24	35.0132	0.7032	35.0152	28.8087	0.8415	0.0423	
09/10/2018 08:05	282	3.4092	-25.7470	U3	1	35.3180	0.7247	35.3180	28.3596	0.8379	0.0732	
09/10/2018 12:00	282	2.7481	-25.6035	U3	2	35.7218	0.7256	35.7245	27.6485	0.8397	0.0203	
09/10/2018 16:21	282	2.0007	-25.4384	U3	3	35.7955	0.7321	35.7978	28.0331	0.8376	0.0208	
09/10/2018 20:06	282	1.3427	-25.2940	U3	4	35.7896	0.7399	35.7918	27.9078	0.8348	0.0781	
10/10/2018 07:58	283	-0.3665	-24.9980	U3	5	36.0007	0.7346	36.0024	26.7527	0.8305	0.2973	
10/10/2018 12:33	283	-1.1207	-24.9959	U3	6	35.9953	0.7335	35.9932	26.9246	0.8276	0.0686	
10/10/2018 16:03	283	-1.4830	-24.9910	U3	7	36.0182	0.7240	36.0160	27.0711	0.8288	0.0556	
10/10/2018 19:47	283	-2.1356	-24.9894	U3	8	36.1232	0.7139	36.1236	26.9117	0.8285	0.0729	
11/10/2018 08:02	284	-4.1334	-24.9823	U3	9	36.1926	0.7108	36.1908	26.4517	0.8277	0.1034	
11/10/2018 11:59	284	-4.8381	-24.9776	U3	10	36.1055	0.7077	36.1051	26.3238	0.8282	0.0442	
11/10/2018 16:05	284	-5.3458	-24.9718	U3	11	36.0355	0.7159	36.0394	26.4162	0.8263	0.0335	
11/10/2018 20:02	284	-6.0593	-24.9682	U3	12	36.1031	0.7178	36.1041	26.2985	0.8255	0.0741	
12/10/2018 08:01	285	-7.9621	-24.9586	U3	13	36.2911	0.7153	36.2975	26.0503	0.8281	0.0858	
12/10/2018 12:03	285	-8.6368	-24.9539	U3	14	36.3649	0.7217	36.3574	26.0299	0.8275	0.0380	
12/10/2018 16:08	285	-9.1035	-24.9539	U3	15	36.4655	0.7307	36.4608	25.9938	0.8277	0.0241	
12/10/2018 20:22	285	-9.8434	-24.9461	U3	16	36.4307	0.7315	36.4297	25.8567	0.8260	0.0524	
13/10/2018 08:00	286	-11.6867	-24.9339	U3	17	36.6536	0.7276	36.6503	25.2649	0.8268	0.0589	

13/10/2018 11:58	286	-12.0828	-24.9303	U3	18	36.6514	0.7334	36.6533	25.3121	0.8252	0.0446	
13/10/2018 16:00	286	-12.4776	-24.9797	U3	19	36.6675	0.7378	36.6644	25.3553	0.8245	0.0350	
13/10/2018 20:05	286	-13.2489	-24.9552	U3	20	36.8635	0.7340	36.8615	24.8418	0.8246	0.0537	
14/10/2018 08:02	287	-15.2512	-25.0023	U3	21	37.1007	0.7192	37.0955	24.0269	0.8251	0.0618	
14/10/2018 12:00	287	-15.8933	-25.0224	U3	22	37.1199	0.7154	37.1156	23.8760	0.8252	0.0165	
14/10/2018 16:00	287	-16.3475	-25.0416	U3	23	37.1788	0.7129	37.1728	24.1333	0.8253	0.0345	
14/10/2018 21:01	287	-17.1636	-25.0609	U3	24	37.0144	0.7083	37.0096	23.7360	0.8263	0.0432	
15/10/2018 07:57	288	-18.5528	-25.0896	U2	1	36.8699	0.7070	36.8673	23.3344	0.8257	0.0278	
15/10/2018 12:31	288	-18.5784	-25.0864	U2	2	36.8751	0.7077	36.8709	23.4776	0.8245	0.0034	
15/10/2018 16:19	288	-18.5451	-25.0801	U2	3	36.8731	0.7076	36.8707	23.4656	0.8241	0.0134	
15/10/2018 19:59	288	-18.9719	-25.0841	U2	4	36.9133	0.7220	36.9096	23.5107	0.8234	0.0295	
16/10/2018 08:01	289	-20.7784	-25.0582	U2	5	36.9211	0.7262	36.9136	23.1652	0.8227	0.0273	
16/10/2018 16:05	289	-21.9372	-25.0362	U2	6	36.9750	0.7073	36.9733	23.1765	0.8222	0.0472	
16/10/2018 11:54	289	-21.4502	-25.0467	U2	7	37.0048	0.7125	37.0002	23.2550	0.8217	0.0146	
16/10/2018 20:03	289	-22.6194	-25.0248	U2	8	36.8972	0.7132	36.8974	22.8468	0.8233	0.0497	
17/10/2018 09:04	290	-24.4548	-25.4560	U2	9	36.6402	0.7211	36.6360	21.6467	0.8244	0.0463	
17/10/2018 12:10	290	-24.8225	-25.8288	U2	10	36.6017	0.7225	36.5932	21.5015	0.8274	0.0082	
17/10/2018 16:03	290	-25.1363	-26.1514	U2	11	36.6826	0.7236	36.6804	21.9907	0.8346	0.0086	
17/10/2018 20:03	290	-25.5437	-26.5810	U2	12	36.6343	0.7215	36.6283	21.6430	0.8384	0.0475	
18/10/2018 08:00	291	-26.9173	-27.9595	U2	13	36.4904	0.7056	36.4853	20.6687	0.8535	0.0454	
18/10/2018 14:51	291	-27.4687	-28.5123	U2	14	36.5036	0.7013	36.4989	21.0866	0.8663	-0.0040	

18/10/2018 16:06	291	-27.6195	-28.6510	U2	15	36.4936	0.7155	36.4825	21.1752	0.8693	-0.0008	
18/10/2018 20:12	291	-28.1110	-29.1727	U2	16	36.6045	0.7188	36.5995	21.5497	0.8728	0.0530	
19/10/2018 08:00	292	-29.4284	-30.5460	U2	17	36.1133	0.7231	36.1069	19.9159	0.8816	0.0302	
19/10/2018 11:55	292	-29.9062	-31.0355	U2	18	36.0105	0.7034	35.9995	19.5397	0.8745	-0.0030	
19/10/2018 16:00	292	-30.2526	-31.4035	U2	19	35.8282	0.7113	35.8213	18.4733	0.8785	0.0397	
19/10/2018 20:10	292	-30.7737	-31.9644	U2	20	35.8592	0.6995	35.8540	18.3953	0.8833	0.0270	
20/10/2018 08:01	293	-31.7971	-33.0624	U2	21	35.9898	0.7148	35.9829	18.6744	0.8884	0.0904	
20/10/2018 12:00	293	-32.2647	-33.5617	U2	22	35.9731	0.7057	35.9665	18.4406	0.8924	-0.0100	
20/10/2018 16:22	293	-32.4856	-33.7993	U2	23	35.9767	0.7213	35.9695	18.5317	0.8918	0.0289	
20/10/2018 20:26	293	-32.9769	-34.3333	U2	24	35.9622	0.6779	35.9554	18.2119	0.8957	0.1067	
21/10/2018 08:00	294	-34.0505	-35.5071	U4	1	35.6411	0.6707	35.6522	16.5897	0.8987	0.1187	
21/10/2018 11:56	294	-34.4789	-35.9826	U4	2	35.5944	0.6605	35.6066	16.3900	0.8997	0.0675	
21/10/2018 16:06	294	-34.7042	-36.2234	U4	3	35.5992	0.6704	35.6095	16.4365	0.8971	0.0503	
21/10/2018 20:15	294	-35.2068	-36.7904	U4	4	35.6113	0.6694	35.6207	16.3062	0.8970	0.3535	
22/10/2018 07:59	295	-36.4319	-38.1683	U4	5	35.7201	0.6802	35.7291	15.4925	0.9012	0.6536	
22/10/2018 14:51	295	-37.0475	-38.8733	U4	6	35.9097	0.6765	35.9207	16.7386	0.9021	0.2174	
22/10/2018 16:02	295	-37.1852	-39.0323	U4	7	35.8961	0.6801	35.8994	16.4385	0.8988	0.4562	
22/10/2018 20:04	295	-37.6776	-39.5941	U4	8	35.5856	0.6786	35.5931	15.4148	0.8843	1.1328	
23/10/2018 07:57	296	-38.8187	-40.9184	U4	9	35.3736	0.6774	35.3810	14.1150	0.8843	1.2555	
23/10/2018 11:55	296	-39.1554	-41.3745	U4	10	34.9845	0.6602	34.9925	12.7197	0.8753	0.6917	
23/10/2018 17:01	296	-39.3853	-41.6987	U4	11	35.1057	0.6652	35.1127	13.1057	0.8779	0.6910	

23/10/2018 19:43	296	-39.6435	-42.0145	U4	12	35.0934	0.6625	35.0994	12.9800	0.8812	1.1046	
24/10/2018 08:00	297	-40.7748	-43.3661	U4	13	35.0194	0.6678	35.0266	12.5914	0.8816	1.2462	
24/10/2018 11:55	297	-41.2626	-43.8967	U4	14	34.9761	0.6592	34.9829	12.2789	0.8846	0.4644	
24/10/2018 16:12	297	-41.5104	-44.1794	U4	15	34.9959	0.6626	35.0020	12.4576	0.8794	0.5473	
24/10/2018 20:01	297	-41.9631	-44.7160	U4	16	34.6795	0.6646	34.6846	11.4685	0.8772	1.2429	
25/10/2018 08:57	298	-43.2541	-46.2859	U4	17	34.7681	0.6563	34.7732	11.5129	0.8795	0.9511	Ships time back one hour to GMT -1 hour
25/10/2018 14:38	298	-43.7905	-46.9552	U4	18	34.4959	0.6540	34.5002	9.7928	0.8683	0.6321	
25/10/2018 17:08	298	-43.9978	-47.2235	U4	19	34.5242	0.6565	34.5271	9.8341	0.8703	0.2902	
25/10/2018 21:09	298	-44.4217	-47.7643	U4	20	34.5058	0.6662	34.5149	9.6933	0.8659	0.9911	
26/10/2018 09:09	299	-45.5346	-49.3118	U4	21	34.5307	0.6563	34.5505	9.7903	0.8690	1.0273	
26/10/2018 14:15	299	-46.0176	-49.8723	U4	22	34.6651	0.6430	34.6696	9.7062	0.8506	0.6221	
26/10/2018 16:54	299	-46.1886	-50.0671	U4	23	34.6743	0.6464	34.6802	9.7931	0.8504	0.6270	
26/10/2018 20:37	299	-46.5984	-50.5160	U4	24	34.6763	0.6420	34.6829	9.6555	0.8573	1.0374	
27/10/2018	300											Underway system switched off

Extraction of Algal Pigments for High Performance Liquid Chromatography (HPLC) Analysis

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Cruise Objectives

- Assess the phytoplankton pigment composition along the AMT28 transect at the surface and subsurface chlorophyll maximum.
- Ensure the continuation of a consistent and spatially extensive 23-year time series of phytoplankton pigment structure data along the Atlantic Ocean.
- Contribute, by providing extensive phytoplankton pigment data, to the development and validation of remote sensing algorithms and marine ecosystem models designed to predict and model phytoplankton biomass and community structure.

Methods

Seawater samples were collected from the pre-dawn and noon CTD casts, and from the ship's underway system. 9.5 L polypropylene (PP) carboys - covered in black plastic to keep light out – were used to sample the seawater. Seawater samples were primarily mixed to avoid sedimentation and subsequently filtered through Fisher Scientific GF/F 25 mm ø glass fibre filters. The GF/F filters were always placed on the filtration rig with its smoother side facing down. 2-4 L of seawater were filtered per sample, depending on the extant phytoplankton biomass (e.g. 2 L in more productive waters and 4 L in the oligotrophic gyres). Samples were filtered using a low-to-medium vacuum setting on the vacuum pump. Resulting sample filters were folded into cryovials, flash-frozen in liquid nitrogen and stored in the -80º freezer.

For each station, duplicate samples were taken at both surface (5 m) and the subsurface chlorophyll maximum (ranging between 12-170 m). Two daily samples were also taken using the ship's underway system, one during the noon station and another at night (around 20:00 ship time), in order to compare with surface CTD samples and towards calibrating the ACS optics instrument). Frozen samples are to be analysed following the proceedings of Van Heukelem & Thomas (2001). Tables 1 and 2 show the location, station and details from the CTD and underway system samples, respectively.

References

Van Heukelem, L. and Thomas, C.S. (2001) Computer-assisted high performance liquid chromatography method development with applications to the isolation and analysis of phytoplankton pigments, J. Chromatogr. A, 910, 31–49

Table 1 – Summary of the CTD casts HPLC samples on AMT28.

Date	Time (GMT)	Station	CTD Cast	Lat	Lon	Depths sampled (m)
25/09/2018	1235	1	002	49º 38,285' N	5º 30,096'W	5, 12
26/09/2018	0334	2	003	48º 28,165' N	8º 50,193' W	5, 60
26/09/2018	1210	3	004	47º 54,073’ N	10º 23,884’ W	5, 30
27/09/2018	0330	4	004	46º 01,745' N	12º 43,950’ W	5, 60
27/09/2018	1207	5	005	44º 58,715' N	13º 35,363’ W	5, 40
28/09/2018	0333	6	006	42º 58,022’ N	15º 12,784’ W	5, 52
28/09/2018	1201	7	007	41º54,700' N	16º02,179’ W	5, 52
29/09/2018	0334	8	008	39º 43,158 ' N	17º 42,968' W	5, 71
29/09/2018	1200	9	009	38º 37,851' N	18º 31,541' W	5, 70
30/09/2018	0434	10	010	36º 24,836' N	20º 07,287' W	5, 105
30/09/2018	1259	11	011	35º 18,121' N	20º 54,912' W	5, 105
01/10/2018	0438	12	012	33º 2,816' N	22º 08',206' W	5, 90
01/10/2018	1307	13	013	31º 55,442' N	22º 42,611' W	5, 85
02/10/2018	0437	14	014	29º 29,299'N	23º 55,948' W	5, 114
02/10/2018	1050	15	015	28º 36,544' N	24º 21,650' W	5, 135
03/10/2018	0437	16	016	26º 12,227' N	25º 31,264' W	5, 107
03/10/2018	1301	17	017	25º 03,461' N	26º 03,408' W	5, 120
04/10/2018	0437	18	018	22º 35,980' N	27º 12,800' W	5, 93
04/10/2018	1301	19	019	21º 26.830' N	27º 44.720' W	5, 120
05/10/2018	0438	20	020	19º 04,664' N	28º 49,004' W	5, 93
05/10/2018	1301	21	021	17º 44,837' N	28º 55,814' W	5, 65
06/10/2018	0438	22	022	15º 04, 566' N	28º 36,756' W	5, 57
06/10/2018	1301	23	023	13º 48,630' N	28º 17,763' W	5, 60
07/10/2018	0437	24	024	11º 26,819'N	27º 42,524' W	5, 50
07/10/2018	1300	25	025	10º 05,894'N	27º 17,629' W	5, 40

08/10/2018	0438	27	026	07º 28,277' N	26º 39,007' W	5, 72
08/10/2018	1302	28	027	06º 15,359' N	26º 22,796' W	5, 64
09/10/2018	0439	29	028	03º 48,465' N	25º 50,148' W	5, 89
10/10/2018	0446	30	029	00º 00,031' S	24º 59,953' W	5, 60
10/10/2018	1304	31	030	01º 09,109' S	24º 59,435' W	5, 75
11/10/2018	0430	32	031	03º 41,467' S	24º 58,694' W	5, 60
11/10/2018	1302	33	032	04º 59,077' S	24º 58,392' W	5, 74
12/10/2018	0439	34	033	07º 32,922' S	24º 57,444' W	5, 110
12/10/2018	1301	35	034	08º 45,785' S	24º 56,904' W	5, 120
13/10/2018	0435	36	035	11º 15,739' S	24º 56,250' W	5, 122
13/10/2018	1033	37	036	12º 04,969' S	24º 55,818' W	5, 111
14/10/2018	0435	38	037	14º 46,784' S	24º 59,086' W	5, 145
14/10/2018	1307	40	038	16º 01,942' S	25º 01,412' W	5, 160
15/10/2018	0435	41	039	18º 20,357' S	25º 05,143' W	5, 152
16/10/2018	0449	43	040	20º 22,761' S	25º 03,565' W	5, 161
16/10/2018	1301	44	041	21º 36,224' S	25º 02,786' W	5, 170
17/10/2018	0431	45	042	23º 59,974' S	24º 59,965' W	5, 140
17/10/2018	1303	46	043	24º 54,350' S	25º 54,196' W	5, 140
18/10/2018	0443	47	044	26º 37,678' S	27º 39,321' W	5, 127
18/10/2018	1036	48	045	27º 12,003' S	28º 15,001' W	5, 140
19/10/2018	0436	49	046	29º 07,655' S	30º 13,409' W	5, 130
19/10/2018	1301	50	047	30º 00,355' S	31º 06,982' W	5, 109
20/10/2018	0445	51	048	31º 37,104' S	32º 53,058' W	5, 131
20/10/2018	1312	52	049	32º 22,371' S	33º 40,448' W	5, 85
21/10/2018	0440	53	050	33º 49,894' S	35º 16,130' W	5, 80
21/10/2018	1310	54	051	34º 34,830' S	36º 05,486' W	5, 70
22/10/2018	0445	55	052	36º 10,029' S	37º 51,980' W	5, 70
22/10/2018	1315	56	053	37º 00,723' S	38º 50,077' W	5, 40

23/10/2018	0437	57	054	38º 35,043' S	40º 39,307' W	7, 65
23/10/2018	1311	58	055	39º 12,560' S	41º 28,505' W	8, 30
24/10/2018	0441	59	056	40º 31,255' S	43º 04,973' W	5, 40
24/10/2018	1309	60	057	41º 22,179' S	44º 00,764' W	5, 35
25/10/2018	0540	61	058	43º 00,361' S	45º 58,902' W	5, 55
25/10/2018	1406	62	059	43º 47,429' S	46º 57,313' W	5, 38
26/10/2018	0538	63	060	45º 17,852' S	48º 53,785' W	5, 53
26/10/2018	1409	64	061	46º 01,052' S	49º 52,339' W	5, 30
27/10/2018	0637	65	062	47º 33,709' S	51º 46,436' W	5, 66
27/10/2018	1503	66	063	48º 11,932' S	52º 41,362' W	5, 40

Table 2 – Summary of the underway system HPLC samples on AMT28.

Date	Time (GMT)	Station	Lat	Lon	Depths sampled (m)
26/09/2018	1250	AA	47°54.074'N	10°22.885'W	5
26/09/2018	1853	AB	47°21.610'N	11°37.041'W	5
27/09/2018	1252	AC	44°58.715'N	13°35.36'W	5
27/09/2018	1925	AD	43°51.548'N	14°30.508'W	5
28/09/2018	1227	AE	41°54.700'N	16°02.179'W	5
28/09/2018	1935	AF	40°47.320'N	16°54.317'W	5
29/09/2018	1225	AG	38°37.851'N	18°31.541'W	5
29/09/2018	1937	AH	37°45.555'N	19°09.603'W	5
30/09/2018	1334	AI	35°18.121'N	20°54.912'W	5
30/09/2018	1945	AJ	34°27.315'N	21°24.378'W	5
01/10/2018	1343	AK	31°55.442'N	22°42.611W	5
01/10/2018	2040	AL	30°47.574'N	23°17.178'W	5
02/10/2018	1343	AM	28°36.544'N	24°21.650'W	5
02/10/2018	2042	AN	27°45.850'N	24°46.320'W	5
03/10/2018	1340	AO	25°3.461'N	26°3.408'W	5
03/10/2018	2043	AP	23°57.279'N	26°35.125'W	5

04/10/2018	1340	AQ	21°26.830'N	27°44.720'W	5
04/10/2018	2015	AR	20°31.965'N	28°10.032'W	5
05/10/2018	1348	AS	17°44.839'N	28°55.814'W	5
05/10/2018	2015	AT	16°35.861'N	28°57.739'W	5
06/10/2018	1343	AU	13°48.730'N	28°17.673'W	5
06/10/2018	2053	AV	12°30.818'N	27°58.420'W	5
07/10/2018	1328	AX	10°5.894'N	27°17.629'W	5
07/10/2018	2015	AW	08°42.729'N	26°55.857'W	5
08/10/2018	1340	AY	06°15.359'N	26°22.796'W	5
08/10/2018	2023	AZ	05°12.009'N	26°08.523'W	5
09/10/2018	2040	BA	01°12.138'N	24°59.435'W	5
10/10/2018	1343	BB	01°9.109'S	24°59.435'W	5
10/10/2018	2115	BC	02°27.508'S	24°59.245'W	5
11/10/2018	1342	BD	04°59.077'S	24°58.392'W	5
11/10/2018	2043	BE	06°11.458'S	24°58.009'W	5
12/10/2018	1338	BF	08°45.785'S	24°56.904'W	5
12/10/2018	2053	BG	09°57.476'S	24°56.730'W	5
13/10/2018	1331	BH	12°4.969'S	24°55.818'W	5
13/10/2018	1943	BI	13°13.998'S	24°57.294'W	5
14/10/2018	1347	BJ	16°1.942'S	25°1.412'W	5
14/10/2018	1956	BK	17°0.989'S	25°3.417'W	5
15/10/2018	1343	BL	18°34.708'S	25°5.185'W	5
15/10/2018	1958	BM	19°01.466'S	25°5.046'W	5
16/10/2018	1338	BN	21°36.224'S	25°2.786'W	5
16/10/2018	1957	BO	22°48.540'S	25°1.441'W	5
17/10/2018	1338	BP	24°54.35'S	25°54.196'W	5
17/10/2018	2044	BQ	25°38.621'S	26°40.649'W	5
18/10/2018	1230	BR	27°12.003'S	28°15.011'W	5
18/10/2018	2030	BS	28°09.559'S	29°13.664'W	5

19/10/2018	1344	BT	30°0.355'S	31°8.982'W	5
19/10/2018	2014	BU	30°46.447'S	31°57.894'W	5
20/10/2018	1515	BV	32°22.371'S	33°40.448'W	5
20/10/2018	2126	BX	33°05.817'S	34°27.761'W	5
21/10/2018	1555	BW	34°34.830'S	36°5.486'W	5
21/10/2018	2025	BY	35°19.405'S	36°55.129'W	5
22/10/2018	1354	BZ	37°0.723'S	38°50.077'W	5
22/10/2018	2020	CA	37°44.161'S	39°39.648'W	5
23/10/2018	1457	CB	39°12.560'S	41°28.501'W	5
23/10/2018	2019	CC	39°42.036'S	42°05.176'W	5
24/10/2018	1455	CD	41°22.179'S	44°0.764'W	5
24/10/2018	1958	CE	41°58.384'S	44°43.668'W	5
25/10/2018	1451	CF	43°47.429'S	46°57.313'W	5
25/10/2018	2051	CG	44°24.629'S	47°45.020'W	5
26/10/2018	1522	CH	46°01.052'S	49°52.339'W	5
26/10/2018	2050	CI	46°37.986'S	50°33.285'W	5
27/10/2018	1551	CJ	48°11.932'S	52°41.362'W	5

Effects of Saharan Dust on Coccolithophore Communities

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Cruise Objectives

Explore the potential role of Saharan dust as a nutrient fertilizer for marine phytoplankton in the Atlantic Ocean, particularly on the biogeochemically important coccolithophores. To that aim, the following samples were collected: (a) plankton samples for the study of the coccolithophore communities, and (b) aerosol samples to quantify the amount and composition of dust deposited in the ocean and investigate their link to changes in phytoplankton biomass, N-fixing organisms and coccolithophore species.

Methods

For the coccolithophore analysis, 2 to 5 L of water was taken directly from the Niskin bottles of the CTD-rosette, sampled at discrete water depths from the surface to the base of the photic layer. The samples were then filtered through cellulose nitrate filters (47 mm diameter, 0.45 µm pore size) by means of a water jet pump immediately on board. After filtering, the filters were washed with a solution of Na_2CO_3 + $NaHCO_3$, dried at room temperature and stored in petri dishes.

Species composition and abundance will be further determined at MARE-FCUL by taxonomic identification and counting on measured filter transects, using Polarising Light- and Scanning Electron Microscopes (SEM).

For the dust analysis, samples were collected using an Anderson high-volume dust collector, which sucks air through an air filter, covered with a rain cover. The dust collector was mounted on the deck above the bridge of the ship. Cellulose acetate filters were used to collect the dust by placing them on the dust collector for 24-48 h, depending on the aerosol deposition (e.g. 24 h in areas with higher depositions, 48 h if aerosol deposition was noticeably low after 24 h). The dust collector was equipped with a logger to monitor the volume of air collected and increase the suction when the filter got loaded with material, so that the air flow was kept constant. The filter cassette was taken from the dust collector, and the filter unloaded and replaced safely under a laminar flow cabinet in the laboratory. Resulting filters were stored in the ship's -20ºC freezerand will later be analysed for trace elements, as well as dust particle-size and bulk-composition.

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Table 1: Seawater sampling from CTD casts for coccolithophore analysis

Date	Time	Station No	CTD Cast	Lat	Lon (W)	Depths Sampled (m)
25/09/2018	1235	01	01	49º 38,285' N	5º 30,096'	80; 60; 22; 12; 5
26/09/2018	0334	02	02	48º 28,165' N	8º 50,193'	100; 60; 20; 10; 5
26/09/2018	1210	03	03	47º 54,073' N	10º 23,884'	150; 50; 30; 20; 5
27/09/2018	0330	04	04	46º 01,745' N	12º 43,950'	150; 70; 20; 10; 5
27/09/2018	1207	05	05	44º 58,715' N	13º 35,363'	150; 50; 40; 20; 5
28/09/2018	0333	06	06	42º 58,022' N	15º 12,784'	150; 60; 52; 20; 5
28/09/2018	1201	07	07	41º54,700' N	16º02,179'	150; 56; 50; 20; 5

29/09/2018	0334	08	08	39º 43,158’ N	17º 42,968'	150; 81; 71; 20; 5
29/09/2018	1200	09	09	38º 37,851' N	18º 31,541'	150; 70; 50; 20; 5
30/09/2018	0436	10	10	36º 24,836' N	20º 07,287'	150; 115; 105; 20; 5
30/09/2018	1259	11	11	35º 18,121' N	20º 54,912'	150; 105; 50; 20; 5
01/10/2018	0438	12	12	33º 2,816' N	22º 08',206'	150; 100; 90; 50; 5
01/10/2018	1307	13	13	31º 55,442' N	22º 42,611'	150; 120; 85; 50; 5
02/10/2018	0435	14	14	29º 29,299'N	23º 55,948'	200; 150; 114; 50; 5
02/10/2018	1050	15	15	28º 36,544' N	24º 21,650'	200; 150; 135; 50; 5
03/10/2018	0436	16	16	26º 12,227' N	25º 31,264'	200; 150; 107; 50; 5
03/10/2018	1301	17	17	25º 03,461' N	26º 03,408'	200; 140; 120; 50; 5
04/10/2018	0436	18	18	22º 35,980' N	27º 12,800'	200; 150; 93; 50; 5
04/10/2018	1301	19	19	21º 26.830' N	27º 44.720'	200; 140; 120; 50; 5
05/10/2018	0438	20	20	19º 04,664' N	28º 49,004'	200; 150; 90; 50; 5
05/10/2018	1301	21	21	17º 44,837' N	28º 55,814'	200; 100; 65; 50; 5
06/10/2018	0438	22	22	15º 04, 566' N	28º 36,756'	150; 100; 57; 20; 5
06/10/2018	1301	23	23	13º 48,630' N	28º 17,763'	150; 85; 60; 50; 5
07/10/2018	0437	24	24	11º 26,819'N	27º 42,524'	150; 100; 50; 20; 5
07/10/2018	1300	25	25	10º 05,894'N	27º 17,629'	150; 70; 40; 20; 5
08/10/2018	0438	27	26	07º 28,277' N	26º 39,007'	150; 100; 72; 50; 5
08/10/2018	1302	28	27	06º 15,359' N	26º 22,796'	150; 85; 64; 30; 5
09/10/2018	0439	29	28	03º 48,465' N	25º 50,148'	200; 150; 89; 50; 5
10/10/2018	0446	30	29	00º 00,031' S	24º 59,953'	150; 70; 60; 50; 5
10/10/2018	1304	31	30	01º 09,109' S	24º 59,435'	120; 90; 75; 30; 5
11/10/2018	0460	32	31	03º 41,467' S	24º 58,694'	150; 90; 60; 50; 5
11/10/2018	1302	33	32	04º 59,077' S	24º 58,392'	125; 90; 74; 50; 5
12/10/2018	0439	34	33	07º 32,922' S	24º 57,444'	200; 150; 110; 50; 5
12/10/2018	1301	35	34	08º 45,785' S	24º 56,904'	175; 135; 120; 65; 5
13/10/2018	0435	36	35	11º 15,739' S	24º 56,250'	200; 150; 122; 110; 5
13/10/2018	1033	37	36	12º 04,969' S	24º 55,818'	200; 150; 111; 50; 5

14/10/2018	0435	38	37	14º 46,784' S	24º 59,086'	200; 150; 145; 55; 5
14/10/2018	1307	40	38	16º 01,942' S	25º 01,412'	250; 185; 160; 75; 5
15/10/2018	0435	41	39	18º 20,357' S	25º 05,143'	200; 152; 100; 50; 5
16/10/2018	0449	43	40	20º 22,761' S	25º 03,565'	200; 161; 100; 50; 5
16/10/2018	1301	44	41	21º 36,224' S	25º 02,786'	250; 185; 170; 125; 5
17/10/2018	0431	45	42	23º 59,974' S	24º 59,965'	200; 140; 100; 50; 5
17/10/2018	1303	46	43	24º 54,350' S	25º 54,196'	250; 180; 140; 50; 5
18/10/2018	0443	47	44	26º 37,678' S	27º 39,321'	200; 127; 100; 50; 5
18/10/2018	1036	48	45	27º 12,003' S	28º 15,001'	300; 200; 140; 100; 5
19/10/2018	0436	49	46	29º 07,655' S	30º 13,409'	200; 150; 130; 50; 5
19/10/2018	1301	50	47	30º 00,355' S	31º 06,982'	250; 150; 109; 50; 5
20/10/2018	0444	51	48	31º 37,104' S	32º 53,058'	200; 131; 100; 50; 5
20/10/2018	1312	52	49	32º 22,371' S	33º 40,448'	200; 150; 85; 50; 5
21/10/2018	0440	53	50	33º 49,894' S	35º 16,130'	200; 150; 80; 50; 5
21/10/2018	1310	54	51	34º 34,830' S	36º 05,486'	150; 100; 70; 50; 5
22/10/2018	0445	55	52	36º 10,029' S	37º 51,980'	200; 130; 70; 20; 5
22/10/2018	1315	56	53	37º 00,723' S	38º 50,077'	120; 70; 40; 15; 5
23/10/2018	0437	57	54	38º 35,043' S	40º 39,307'	200; 100; 65; 20; 7
23/10/2018	1311	58	55	39º 12,560' S	41º 28,505'	200; 75; 30; 15; 8
24/10/2018	0441	59	56	40º 31,255' S	43º 04,973'	200; 100; 40; 20; 5
24/10/2018	1309	60	57	41º 22,179' S	44º 00,764'	200; 100; 75; 20; 5
25/10/2018	0540	61	58	43º 00,361' S	45º 58,902'	200; 140; 55; 20; 5
25/10/2018	1406	62	59	43º 47,429' S	46º 57,313'	135; 70; 38; 15; 5
26/10/2018	1409	63	61	46º 01,052' S	49º 52,339'	200; 135; 50; 30; 5
27/10/2018	0637	64	62	47º 33,709' S	51º 46,436'	200; 100; 66; 20; 5
27/10/2018	1503	65	63	48º 11,932' S	52º 41,362'	200; 100; 40; 20; 5

Table 2: Summary of the aerosol samples during AMT28. Date, time, latitude and longitude shown for each sample correspond to the start of the sampling.

Sample	Date (start)	Time (start) (GMT)	Lat (start)	Lon (start)
AA	23/09/2018	1858	50º45.810'N	0º54.968'E
AB	24/09/2018	0745	50º48.424'N	1º06.640'W
AC	25/09/2018	0817	49º59.534'N	4º29.717'W
AD	26/09/2018	1900	47º21.610'N	11º37.041'W
AE	28/09/2018	1904	40º58.446'N	16º45.727'W
AF	29/09/2018	1915	37º45.555'N	19º09.603'W
AG	30/09/2018	1927	34º27.315'N	21º24.378'W
AH	01/10/2018	1911	31º07.699'N	23º07.130'W
AI	02/10/2018	1923	27º45.850'N	24º46.320'W
AJ	03/10/2018	2046	23º57.279'N	26º35.125'W
AK	04/10/2018	1933	20º31.965'N	28º10.032'W
AL	05/10/2018	1917	16º45.869'N	28º58.861'W
AM	06/10/2018	1927	12º30.818'N	27º58.420'W
NA	07/10/2018	1917	8º54.555'N	26º58.226'W
AO	08/10/2018	2011	5º12.009'N	26º08.523'W
AP	09/10/2018	1927	1º27.480'N	25º19.188'W
AQ	10/10/2018	1941	2º07.049'S	24º59.338'W
AR	11/10/2018	1925	5º56.540'S	24º58.092'W
AS	12/10/2018	1918	9º38.772'S	24º56.849'W
AT	13/10/2018	1917	13º05.586'S	24º57.088'W
AU	14/10/2018	1918	16º52.862'S	25º03.196'W
AV	15/10/2018	1921	18º51.593'S	25º05.058'W
AW	16/10/2018	1920	22º28.529'S	25º01.663'W
AX	18/10/2018	1930	28º00.886'S	29º04.087'W
AY	20/10/2018	1855	32º47.563'S	34º08.144'W
AZ	22/10/2018	1914	37º34.490'S	39º28.578'W
BA	24/10/2018	1931	41º54.363'S	44º38.907'W

Distribution of Phytoplankton Communities in the Atlantic Ocean

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Cruise Objectives

The main goal is to understand the ecology and distribution of phytoplankton communities thriving in the Atlantic Ocean. Furthermore, we would like to contribute to the validation of Phytoplankton Size Classes (PSCs) and Phytoplankton Functional Types (PFTs) obtained by remote sensing ocean colour with our *in situ* observations.

Methods

0.3 L of seawater was collected from Niskin bottles from each cast CTD at the surface and the deep chlorophyll *a* maximum (DCM). 150 mL samples were taken and subsequently fixed with acid Lugol's iodine solution (~7,5 mL) in brown-glass flasks and stored in a cool place. Samples will be further analysed with an inverted microscope in the lab at MARE-FCUL for estimating cells abundance and phytoplankton species composition (>10 µm). Samples will be analysed by optical microscopy, in the University of Lisbon, following the proceedings of Utermöhl (1958). Results from the microscope counts and from the flow cytometer (see next report) will be treated jointly (estimating biovolume and carbon per cell content), in order to get a complete survey of phytoplankton groups, from picoplankton cells to diatoms, dinoflagellates and coccolithophores.

References

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Table 1: Summary of the CTD casts phytoplankton samples.

Date	Time	Station No	CTD Cast	Lat	Lon (W)	Depths Sampled (m)
25/09/2018	1235	01	01	49º 38,285'	5º 30,096'	5
26/09/2018	0334	02	02	48º 28,165'	8º 50,193'	5, 60
26/09/2018	1210	03	03	47º 54,073	10º 23,884	5; 30
27/09/2018	0330	04	04	46º 01,745'	12º 43,950	5; 60
27/09/2018	1207	05	05	44º 58,715'	13º 35,363	5; 40
28/09/2018	0333	06	06	42º 58,022	15º 12,784	5; 52
28/09/2018	1201	07	07	41º54,700'	16º02,179	5; 56
29/09/2018	0334	08	08	39º 43,158 '	17º 42,968'	5; 71
29/09/2018	1200	09	09	38º 37,851'	18º 31,541'	5; 70
30/09/2018	0436	10	10	36º 24,836'	20º 07,287'	5; 105

30/09/2018	1259	11	11	35º 18,121'	20º 54,912'	5; 105
01/10/2018	0438	12	12	33º 2,816'	22º 08',206'	5; 90
01/10/2018	1307	13	13	31º 55,442' N	22º 42,611'	5; 85
02/10/2018	0435	14	14	29º 29,299'N	23º 55,948'	5; 114
02/10/2018	1050	15	15	28º 36,544' N	24º 21,650'	5; 135
03/10/2018	0436	16	16	26º 12,227' N	25º 31,264'	5; 107
03/10/2018	1301	17	17	25º 03,461' N	26º 03,408'	5; 120
04/10/2018	0436	18	18	22º 35,980' N	27º 12,800'	5; 93
04/10/2018	1301	19	19	21º 26.830' N	27º 44.720'	5; 120
05/10/2018	0438	20	20	19º 04,664' N	28º 49,004'	5; 90
05/10/2018	1301	21	21	17º 44,837' N	28º 55,814'	5; 65
06/10/2018	0438	22	22	15º 04, 566' N	28º 36,756'	5; 57
06/10/2018	1301	23	23	13º 48,630' N	28º 17,763'	5;60
07/10/2018	0437	24	24	11º 26,819'N	27º 42,524'	5; 50
07/10/2018	1300	25	25	10º 05,894'N	27º 17,629'	5; 40
08/10/2018	0438	27	26	07º 28,277' N	26º 39,007'	5; 72
08/10/2018	1302	28	27	06º 15,359' N	26º 22,796'	5; 64
09/10/2018	0439	29	28	03º 48,465' N	25º 50,148'	5; 89
10/10/2018	0446	30	29	00º 00,031' S	24º 59,953'	5; 60
10/10/2018	1304	31	30	01º 09,109' S	24º 59,435'	5; 75
11/10/2018	0460	32	31	03º 41,467' S	24º 58,694'	5; 60
11/10/2018	1302	33	32	04º 59,077' S	24º 58,392'	5; 74
12/10/2018	0439	34	33	07º 32,922' S	24º 57,444'	5; 120
12/10/2018	1301	35	34	08º 45,785' S	24º 56,904'	5; 120
13/10/2018	0435	36	35	11º 15,739' S	24º 56,250'	5; 122
13/10/2018	1033	37	36	12º 04,969' S	24º 55,818'	5; 111
14/10/2018	0435	38	37	14º 46,784' S	24º 59,086'	5; 145
14/10/2018	1307	40	38	16º 01,942' S	25º 01,412'	5; 160
15/10/2018	0435	41	39	18º 20,357' S	25º 05,143'	5; 150

16/10/2018	0449	43	40	20º 22,761' S	25º 03,565'	5; 161
16/10/2018	1301	44	41	21º 36,224' S	25º 02,786'	5; 170
17/10/2018	0431	45	42	23º 59,974' S	24º 59,965'	5; 140
17/10/2018	1303	46	43	24º 54,350' S	25º 54,196'	5; 140
18/10/2018	0443	47	44	26º 37,678' S	27º 39,321'	5; 127
18/10/2018	1036	48	45	27º 12,003' S	28º 15,001'	5; 140
19/10/2018	0436	49	46	29º 07,655' S	30º 13,409'	5; 130
19/10/2018	1301	50	47	30º 00,355' S	31º 06,982'	5; 109
20/10/2018	0444	51	48	31º 37,104' S	32º 53,058'	5; 131
20/10/2018	1312	52	49	32º 22,371' S	33º 40,448'	5; 85
21/10/2018	0440	53	50	33º 49,894' S	35º 16,130'	5; 80
21/10/2018	1310	54	51	34º 34,830' S	36º 05,486'	5; 70
22/10/2018	0445	55	52	36º 10,029' S	37º 51,980'	5; 70
22/10/2018	1315	56	53	37º 00,723' S	38º 50,077'	5; 40
23/10/2018	0437	57	54	38º 35,043' S	40º 39,307'	5; 65
23/10/2018	1311	58	55	39º 12,560' S	41º 28,505'	5; 30
24/10/2018	0441	59	56	40º 31,255' S	43º 04,973'	5; 40
24/10/2018	1309	60	57	41º 22,179' S	44º 00,764'	5; 35
25/10/2018	0540	61	58	43º 00,361' S	45º 58,902'	5; 55
25/10/2018	1406	62	59	43º 47,429' S	46º 57,313'	5; 38
26/10/2018	0538	63	60	45º 17,852' S	48º 53,785'	5; 53
26/10/2018	1409	64	61	46º 01,052' S	49º 52,339'	5; 30
27/10/2018	0637	64	61	47º 33,709' S	51º 46,436'	5; 66
Date	**Time**	**Station No**	**CTD Cast**	**LAT**	**LONG (W)**	**Depths Sampled (m)**
27/10/2018	1503	64	61	48º 11,932' S	52º 41,362'	5; 40

Abundance and Composition of Microbial Plankton Communities by Flow Cytometry

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Objective

To determine the distribution, abundance and community structure of nano- and picophytoplankton and heterotrophic bacteria from CTD casts by flow cytometry.

Phytoplankton community structure and abundance by flow cytometry.

Fresh seawater samples were collected in clean 250 mL polycarbonate bottles using a Seabird CTD system containing a 24 bottle rosette of 20 L Niskin bottles from 200 m to the surface at predawn and solar noon CTD casts. Samples were stored in a refrigerator and analysed within 2 hours of collection. Fresh samples were measured using a Becton Dickinson FACSort flow cytometer which characterised and enumerated *Prochlorococcus* sp. and *Synechococcus* sp. (cyanobacteria) and pico- and eukaryote phytoplankton, based on their light scattering and autofluorescence properties. Data were saved in listmode format and will be analysed back at the laboratory. Table 1 summarises the CTD casts sampled and analysed during the cruise.

Heterotrophic bacteria community structure and abundance by flow cytometry.

Samples for bacteria enumeration were collected in clean 250 mL polycarbonate bottles using a Seabird CTD system containing a 24 bottle rosette of 20 L Niskin bottles from 200 m to the surface at predawn and solar noon CTD casts. Samples were fixed with glutaraldehyde solution (Sigma-Aldrich, 50%, Grade 1. 0.5% final concentration, 30 mins at 4^{o}C) within an hour of surfacing. Samples (see below) were stained for 1 h at room temperature in the dark with the DNA stain SYBR Green I (Thermo-Fisher) in order to separate particles in suspension based on DNA content and light scattering properties. This enabled bacteria to be discriminated from other particles and enumerated. Samples were generally analysed flow cytometrically within 3 hours of surfacing. Stained samples were measured using a Becton Dickinson FACSort flow cytometer. Data were saved in listmode format and will be analysed back at the laboratory.

Table 1: CTD casts sampled for phytoplankton and heterotrophic bacteria community structure & abundance.

Date	Station no.	CTD cast	Time in water (GMT)	LAT (+ve N)	LON (+ve E)	Niskins sampled	Depths sampled (m)
25/09/18	01	CTD01	12:25	49° 38.287’	-5° 30.096’	1, 3, 5, 6, 9, 10, 13, 16, 20, 21	80, 70, 60, 50, 35, 22, 17, 12, 8, 5
26/09/18	02	CTD02	03:34	48° 28.162’	-8° 50.195’	1, 3, 4, 6, 12, 13, 15, 17, 19, 20	140, 100, 70, 60, 50, 25, 20, 14, 10, 5
26/09/18	03	CTD03	12:10	47° 54.074’	-10° 22.885’	3, 5, 6, 7, 8, 9, 10, 13, 16, 17, 19, 20, 21	200, 150, 130, 100, 75, 60, 50, 30, 25, 20, 15, 10, 5
27/09/18	04	CTD04	03:30	46° 01.745’	-12° 43.951’	1, 3, 4, 6, 12, 13, 15, 17, 19, 20	200, 150, 70, 60, 50, 26, 20, 14, 10, 5
27/09/18	05	CTD05	12:07	44° 58.715’	-13° 35.364’	3, 4, 5, 6, 7, 8, 10, 11, 14,	200, 150, 125, 100, 75,

						15, 16, 17, 20, 21	50, 45, 40, 35, 30, 25, 20, 10, 5
28/09/18	06	CTD06	03:33	42° 58.022’	-15° 12.784’	2, 4, 5, 8, 13, 14, 15, 17, 18, 20, 21	200, 150, 60, 52, 50, 40, 23, 20, 12, 7, 5
28/09/18	07	CTD07	12:01	41° 54.700’	-16° 02.179’	3, 4, 5, 6, 7, 8, 9, 12, 14, 15, 16, 17, 19, 20, 21	200, 150, 125, 100, 80, 70, 56, 50, 45, 30, 25, 20, 15, 10, 5
29/09/18	08	CTD08	03:34	39° 43.158’	-17° 42.968’	1, 3, 4, 8, 12, 13, 15, 17, 19, 20	200, 150, 81, 71, 50, 30, 20, 17, 9, 5
29/09/18	09	CTD09	12:00	38° 37.851’	-18° 31.541’	3, 4, 5, 6, 7, 8, 11, 12, 14, 15, 16, 17, 19, 20, 21	200, 150, 125, 100, 80, 70, 60, 50, 45, 30, 25, 20, 15, 10, 5
30/09/18	10	CTD10	04:34	36° 24.836’	-20° 07.287’	1, 3, 4, 7, 12, 13, 14, 16, 18, 19, 21	200, 150, 115, 105, 60, 50, 45, 25, 20, 14, 5
30/09/18	11	CTD11	12:59	35° 18.121’	-20° 54.912’	3, 4, 5, 6, 7, 10, 11, 12, 13, 15, 16, 18, 20, 21	200, 150, 130, 120, 105, 90, 75, 60, 50, 40, 30, 20, 10, 5
01/10/18	12	CTD12	04:38	33° 02.816’	-22° 08.206’	1, 3, 4, 6, 10, 11, 12, 13, 15, 17, 19, 20, 22	200, 150, 100, 90, 80, 60, 50, 39, 30, 22, 20, 12, 5
01/10/18	13	CTD13	13:07	31° 55.442’	-22° 42.611’	3, 4, 5, 6, 7, 8, 11, 12, 13, 15, 16, 18, 20, 21	200, 150, 130, 120, 100, 85, 75, 60, 50, 40, 30, 20, 10, 5
02/10/18	14	CTD14	04:37	29° 29.300’	-23° 55.947’	1, 4, 5, 8, 13, 14, 15, 17, 19, 20, 21	200, 150, 124, 114, 65, 50, 48, 28, 20, 15, 5
02/10/18	15	CTD15	10:50	28° 36.544’	-24° 21.650’	7, 8, 10, 13, 14, 15, 16, 18, 19, 22	200, 150, 135, 115, 90, 70, 50, 35, 20, 5
03/10/18	16	CTD16	04:37	26° 12.277’	-25° 31.264’	1, 3, 4, 7, 11, 12, 13, 14, 15, 17, 19, 20, 21	200, 150, 117, 107, 90, 76, 60, 50, 45, 25, 20, 14, 5
03/10/18	17	CTD17	13:01	25° 3.461’	-26° 3.408’	3, 4, 5, 6, 7, 10, 11, 12, 13, 15, 16, 18, 20, 21	200, 150, 130, 120, 103, 93, 65, 50, 41, 23, 20, 13, 5
04/10/18	18	CTD18	04:37	22° 35.980’	-27° 12.800’	1, 4, 5, 6, 7, 9, 13, 14, 15, 17, 19, 20, 21	200, 150, 130, 120, 103, 93, 65, 50, 41, 23, 20, 13, 5
04/10/18	19	CTD19	13:01	21°26.830’	-27° 44.720’	3, 4, 5, 6, 7, 10, 11, 12, 13, 14, 16,	200, 150, 140, 130, 120, 105, 85,

						17, 18, 20, 21	75, 65, 50, 40, 30, 20, 10, 5
05/10/18	20	CTD20	04:38	19° 04.664’	-28° 49.004’	1, 3, 4, 10, 11, 12, 13, 16, 19, 21	200, 150, 100, 90, 66, 50, 39, 22, 12, 5
05/10/18	21	CTD21	13:01	17° 44.839’N	-28° 55.814’	3, 4, 5, 6, 7, 8, 9, 12, 13, 14, 16, 17, 18, 20, 21	200, 150, 115, 100, 85, 75, 65, 60, 55, 50, 40, 30, 20, 10, 5
06/10/18	22	CTD22	04:38	15° 04.566’	-28° 36.756’	2, 3, 4, 5, 6, 7, 9, 11, 14, 15, 16, 18, 19, 21, 22	200, 150, 125, 100, 80, 67, 62, 57, 50, 36, 25, 20, 14, 7, 5
06/10/2018	23	CTD23	13:01	13° 48.730’	-28° 17.673’	3, 5, 6, 7, 8, 9, 10, 13, 14, 16, 17, 18, 19, 20, 21	200, 150, 120, 100, 85, 75, 60, 55, 50, 45, 40, 30, 20, 10, 5
07/10/18	24	CTD24	04:37	11° 26.819’	-27° 42.524’	1, 3, 4, 5, 8, 12, 13, 15, 17, 19, 21	200, 150, 100, 60, 50, 30, 22, 20, 12, 7, 5
07/10/18	25	CTD25	13:00	10° 05.894’	-27° 17.629’	1, 2, 3, 4, 6, 7, 10, 11, 12, 13	200, 150, 100, 70, 50, 40, 35, 30, 20, 5
08/10/18	27	CTD26	04:38	07° 28.277’	-26° 39.007’	1, 3, 4, 5, 8, 12, 13, 14, 16, 17, 19, 24	200, 150, 100, 82, 72, 50, 40, 30, 20, 17, 9, 5
08/10/18	28	CTD27	13:02	06° 15.359’	-26° 22.796’	3, 5, 6, 7, 8, 9, 10, 13, 14, 16, 17, 18, 19, 20, 21	200, 150, 120, 100, 85, 70, 64, 54, 50, 45, 40, 30, 20, 13, 5
09/10/18	29	CTD28	04:39	03° 48.465’	-25° 50.148’	1, 3, 4, 5, 8, 12, 13, 14, 15, 17, 19, 20, 21	200, 150, 115, 99, 89, 80, 60, 50, 39, 22, 20, 12, 5
10/10/18	30	CTD29	04:46	00° 00.031’	-24° 59.952’	1, 3, 5, 8, 12, 13, 15, 17, 19, 20	200, 150, 70, 60, 50, 26, 20, 14, 8, 5
10/10/18	31	CTD30	13:04	-01° 09.109’	-24° 59.435’	3, 4, 5, 6, 7, 8, 9, 12, 13, 14, 15, 16, 17, 18, 19	200, 150, 120, 100, 90, 82, 75, 70, 63, 50, 40, 30, 20, 13, 5
11/10/18	32	CTD31	04:30	-03° 41.467’	-24° 58. 694’	1, 3, 4, 5, 6, 9, 14, 15, 17, 18, 20, 21	200, 150, 90, 80, 70, 60, 50, 26, 20, 14, 8, 5
11/10/18	33	CTD32	13:02	-04° 59.077’	-24° 58.392’	3, 4, 5, 6, 7, 8, 9, 12, 13, 14, 15, 16, 17, 18, 19	200, 150, 125, 100, 90, 82, 74, 70, 65, 50, 40, 30, 20, 13, 5
12/10/18	34	CTD33	04:39	-07° 32.922’	-24° 57.444’	1, 4, 5, 8, 12, 13, 16, 18, 19, 20	200, 150, 120, 110, 50, 47, 26, 20, 15, 5

12/10/18	35	CTD34	13:01	-08° 45.785’	-24° 56.904’	3, 4, 5, 6, 7, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20	200, 175, 150, 135, 120, 110, 90, 70, 65, 50, 40, 30, 20, 13, 5
13/10/18	36	CTD35	04:35	-11° 15.739’	-24° 56.250’	1, 3, 4, 7, 11, 12, 13, 14, 16, 17, 19, 20, 21	200, 150, 132, 122, 110, 100, 80, 53, 50, 30, 20, 16, 5
13/10/18	37	CTD36	10:33	-12° 4.969’	-24° 55.818’	10, 11, 13, 15, 16, 17, 19, 20, 23	200, 150, 111, 100, 70, 50, 35, 20, 5
14/10/18	38	CTD37	04:35	-14° 46.784’	-24° 59.086’	1, 4, 6, 7, 12, 13, 15, 17, 19, 21	200, 155, 150, 145, 100, 62, 55, 35, 20, 5
14/10/18	40	CTD38	13:06	-16° 01.942’	-25° 01.412’	4, 5, 6, 8, 12, 13, 14, 15, 16, 17, 18, 19, 20	200, 185, 175, 160, 150, 135, 120, 100, 75, 50, 40, 20, 5
15/10/18	41	CTD39	04:35	-18° 20.357’	-25° 05.143	1, 3, 4, 5, 7, 11, 12, 13, 14, 15, 16, 18, 19, 21, 22	200, 185, 175, 162, 152, 145, 135, 120, 100, 80, 65, 50, 36, 20, 5
16/10/18	43	CTD40	04:38	-20° 22.761’	-25° 03.565’	1, 4, 9, 11, 12, 14, 16, 18, 19, 21	200, 171, 161, 100, 70, 50, 40, 25, 20, 5
16/10/18	44	CTD41	13:01	-21° 36.224’	-25° 2.786’	4, 5, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20	200, 185, 170, 160, 150, 125, 100, 85, 70, 50, 35, 20, 5
17/10/18	45	CTD42	04:31	-23° 59. 974’	-24° 59.965’	1, 3, 4, 5, 8, 12, 13, 14, 15, 17, 18, 20, 21	200, 180, 160, 150, 140, 120, 100, 75, 60, 50, 34, 20, 5
17/10/18	46	CTD43	13:03	-24° 54.35’	-25° 54.196’	4, 5, 7, 9, 12, 13, 14, 15, 16, 17, 18, 20, 24	200, 180, 160, 140, 125, 110, 95, 85, 70, 50, 35, 20, 5
18/10/18	47	CTD44	04:43	-26° 37. 675’	-27° 39.321’	1, 4, 6, 11, 12, 14, 16, 18, 19, 21	200, 137, 127, 100, 56, 50, 30, 20, 17, 5
18/10/18	48	CTD45	10:36	-27° 12.003’	-28° 15.011’	14, 15, 17, 18, 19, 20, 21, 23	200, 140, 100, 75, 60, 50, 25, 5
19/10/18	49	CTD46	04:36	-29° 07.655’	30° 13.409’	1, 3, 4, 7, 11, 12, 13, 14, 16, 17, 19, 20, 21	200, 150, 140, 130, 110, 90, 70, 56, 50, 31, 20, 17, 5
19/10/18	50	CTD47	13:01	-30° 0.355’	-31° 8.982’	4, 5, 7, 8, 9, 13, 16, 17, 18, 19, 20, 21, 22	200, 180, 150, 135, 119, 109, 100, 85, 70, 50, 35, 20, 5

20/10/18	51	CTD48	04:45	-31° 37.104’	-32° 53.058’	1, 4, 6, 11, 12, 14, 16, 18, 19, 21	200, 141, 131, 100, 56, 50, 31, 20, 17, 5
20/10/18	52	CTD49	13:12	-32° 22.371’	-33° 40.448’	14, 15, 16, 18, 19, 20, 21, 24	200, 150, 85, 75, 60, 50, 25, 5
21/10/18	53	CTD50	04:40	-33° 49.894’	-35° 16.130’	1, 3, 4, 5, 6, 9, 13, 14, 15, 16, 18, 20, 21	200, 150, 125, 100, 90, 80, 70, 60, 50, 34, 20, 11, 5
21/10/18	54	CTD51	13:10	-34° 34.830’	-36° 5.486’	14, 15, 16, 17, 19, 20, 21, 23	200, 150, 100, 70, 65, 50, 25, 5
22/10/18	55	CTD52	04:45	-36° 10.029’	-37° 51.980’	1, 4, 5, 7, 12, 13, 15, 17, 19, 21	200, 130, 80, 70, 50, 30, 20, 17, 10, 5
22/10/18	56	CTD53	13:15	-37° 0.723’	-38° 50.077’	3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 16, 17, 18, 19, 20	200, 150, 130, 120, 100, 85, 70, 60, 50, 40, 30, 20, 15, 10, 5
23/10/18	57	CTD54	04:37	-38° 35.043’	-40° 39.307’	1, 3, 4, 5, 6, 7, 10, 11, 12, 13, 14, 15, 17	200, 150, 125, 100, 75, 65, 50, 40, 28, 20, 16, 9, 7
23/10/18	58	CTD55	13:11	-39° 12.560’	-41° 28.501’	14, 15, 16, 17, 18, 19, 21, 23	200, 150, 100, 75, 50, 30, 15, 8
24/10/18	59	CTD56	04:41	-40° 31.255’	-43° 04.973’	1, 4, 5, 7, 12, 13 14, 17, 19, 21	200, 100, 50, 40, 35, 20, 17, 10, 8, 5
24/10/18	60	CTD57	13:09	-41° 22.179’	-44° 0.764’	14, 15, 16, 17, 18, 19, 21, 23	200, 150, 100, 75, 50, 35, 20, 5
25/10/18	61	CTD58	05:40	-43°00.361’	-45° 58.902’	1, 3, 4, 5, 6, 7, 10, 14, 15, 17, 18, 20, 21	200, 140, 120, 100, 80, 65, 55, 50, 24, 20, 15, 7, 5
25/10/18	62	CTD59	14:06	-43° 47.429’	-46° 57.313	3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 16, 17, 18, 19	200, 150, 135, 120, 100, 85, 70, 60, 50, 38, 30, 20, 15, 5
26/10/18	63	CTD60	05:38	-45° 17.852’	-48° 53.783’	1, 3, 4, 6, 11, 12, 14, 16, 18, 21	200, 100, 63, 53, 50, 24, 20, 13, 7, 5
26/10/18	64	CTD61	14:09	-46° 01.052	-49° 52.339’	3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 17, 18, 19	200, 150, 135, 120, 100, 85, 70, 60, 50, 40, 30, 20, 15, 5
27/10/18	65	CTD62	06:37	-47° 33.709’	-51° 46.436’	1, 3, 4, 5, 7, 8, 11, 12, 14, 15, 17, 19	200, 150, 125, 100, 76, 66, 50, 28, 20, 16, 10, 5
27/10/18	63	CTD63	15:03	-48° 11.932’	-52° 41.362’	3, 4, 7, 8, 9, 10, 13, 16, 17, 18	200, 150, 100, 80, 65, 50, 40, 30, 20, 5

Mesoplankton Community Size Structure and abundance

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Methods:

Vertical net hauls were conducted each day at the pre-dawn stations for the collection of mesozooplankton samples (Table 1). A bongo (double) net frame was deployed from the JCR's forward crane and a general purpose winch with 8 mm steel wire. The nets used had 0.57m diameter openings and carried 2 WP-2 nets; one with a 200 µm nylon mesh and a 200 µm mesh cod end and the other with 120 µm mesh and a 63 µm cod end to collect Rhizaria. Nets were generally deployed to a depth of 200-250 m, once off the European continental shelf and then hauled at a rate of 11-12 m min^{-1}, integrated between the depth of deployment and the surface. Nets were washed with seawater whilst still outboard and then brought onboard where the cod ends containing the samples were collected into buckets. Nets were then washed down with fresh water before stowing. The Rhizaria samples were used by Natalia Llopis-Monferrer. The 200 µm sample was passed through a 200 µm sieve and the material retained on the sieve was then washed into a 100 mL plastic bottle containing 10 mL of 37% borax-buffered formaldehyde (4% final concentration) using Milli-Q water. Samples were then stored at 4^{o}C for analysis on return to the UK. Back in the UK, samples will be analysed using a combination of microscopy and FlowCAM to provide information on taxonomic composition, size distribution and abundance.

Table 1: Details of bongo WP-2 net vertical deployments

Date	STN	Event no.	Deploy depth (m)	TIME in water (GMT)	TIME on deck (GMT)	Duration (mins)	LAT +N, -S	LON E	Preserved sample name
26-09-18	2	5	130	03:37	03:51	00:11	48.47	-8.84	Bongo 01
27-09-18	4	10	200	03:28	03:50	00:17	46.03	-12.73	Bongo 02
28-09-18	6	18	200	03:39	04:02	00:16	42.97	-15.21	Bongo 03
29-09-18	8	25	200	03:31	03:53	00:17	39.72	-17.72	Bongo 04
30-09-18	10	32	200	04:28	04:51	00:17	36.41	-20.12	Bongo 05
01-10-18	12	40	200	04:29	04:52	00:17	33.05	-22.14	Bongo 06
02-10-18	14	47	200	04:34	04:56	00:16	28.61	-24.36	Bongo 07
03-10-18	16	55	200	04:30	04:51	00:16	26.20	-25.52	Bongo 08
04-10-18	18	62	200	04:29	04:53	00:17	22.60	-27.21	Bongo 09
05-10-18	20	69	200	04:30	04:52	00:16	19.08	-28.82	Bongo 10
06-10-18	22	76	200	04:31	04:53	00:17	15.08	-28.61	Bongo 11
07-10-18	24	83	200	04:32	04:53	00:16	11.45	-27.71	Bongo 12
08-10-18	27	91	200	04:32	04:54	00:16	7.47	-26.65	Bongo 13
09-10-18	29	96	200	04:33	04:54	00:17	3.81	-25.84	Bongo 14
10-10-18	30	102	200	04:45	05:14	00:16	0.00	-25.00	Bongo 15
11-10-18	32	109	200	04:33	04:56	00:17	-3.69	-24.98	Bongo 16

12-10-18	34	116	200	04:36	05:01	00:16	-7.55	-24.96	Bongo 17
13-10-18	36	123	200	04:30	04:53	00:16	-11.26	-24.94	Bongo 18
14-10-18	38	131	250	04:29	04:56	00:20	-14.78	-24.98	Bongo 19
15-10-18	41	141	250	04:34	05:00	00:20	-18.34	-25.09	Bongo 20
16-10-18	43	146	250	04:35	05:02	00:20	-18.34	-25.09	Bongo 21
17-10-18	45	153	250	04:28	04:54	00:20	-24.00	-25.00	Bongo 22
18-10-18	47	162	250	04:37	05:05	00:21	-26.56	-27.66	Bongo 23
19-10-18	49	172	250	04:30	04:57	00:21	-29.13	-30.22	Bongo 24
20-10-18	51	180	200	04:39	05:05	00:17	-31.62	-32.88	Bongo 25
21-10-18	NO	NET	Wind 26-30 knots at			04:00			
22-10-18	56	196	200	04:32	04:56	00:16	-36.17	-37.86	Bongo 26
23-10-18	NO NET. Wind F5-6			Large waves					
24-10-18	NO NET. Wind F5-6			Large waves					
25-10-18	61	217	200	05:36	06:07	00:18	-43.00	-45.98	Bongo 27
26-10-18	63	223	200	05:31	05:55	00:17	-45.30	-48.90	Bongo 28
27-10-18	65	231	200	06:34	06:58	00:17	-47.56	-51.77	Bongo 29

NOTES									
Date									
26-09-18	Net going under ship. Recovered and redeployed. Deployment to 130m.								
	Water column 148m. Hooching with salps and Nitzschia. Training, Igor/Natalia.								
	1 x 200 µm net and 1 x 120 µm net with a 63 µm cod end								
27-09-18	Training, Igor/Natalia.								
28-09-18	Net done by Igor and me and will be from now on								
29-09-18									
30-09-18									
01-10-18									
02-10-18									
03-10-18									
04-10-18									
05-10-18									
06-10-18	Phosphorescence. Squid, flying fish								
07-10-18	Just N of equatorial counter current. Lots of Trichodesmium								
08-10-18	Sargassum, lots. Pyrosome. 12 x 2.5 cm. Returned to sea								
09-10-18									
10-10-18	EQUATOR. Wire under ship. Held at 200m for 8 mins								
11-10-18									
12-10-18									
13-10-18	Wire going slack. Swell.								

14-10-18	DEPLOYED TO 250 m. Puffer fish attacking the bongo wire								
15-10-18	DEPLOYED TO 250m								
16-10-18	DEPLOYED TO 250m								
17-10-18	DEPLOYED TO 250m								
18-10-18	DEPLOYED TO 250m								
19-10-18									
20-10-18	Broke 200µm net. Replaced. Wind got up. Gusting 30 knots, large swell								
21-10-18									
22-10-18									
23-10-18									
24-10-18									
25-10-18	Issues with spooling/level wind								
26-10-18									
27-10-18									

Bacterial respiration and production; Dissolved Organic Matter

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Objectives and methods

In order to help elucidate oceanic carbon cycling, bacterial production was studied during AMT28 using radiolabelled leucine in production and respiration assays. Additionally, samples were collected for analysis of DOM in the home lab.

Samples were taken from pre-dawn CTD rosette sampler deployments at the surface, the deep chlorophyll maximum (DCM), and the point of 33% light penetration, starting with carboys for DOM using no tubes and avoiding contact with the CTD frame to minimize the risk of contamination; followed by carboys for bacterial production and respiration assays. All materials were acid-cleaned overnight and rinsed just before sampling.

Bacterial production was measured via the rate of ^{3}H-Leucine incorporation after Hill, Warwick, & Zubkov (2013). In short, samples were portioned into subsamples and received ^{3}H-Leucine additions of 0.2, 0.4, 0.6, 0.8 and 1.0 nM and were left to incubate for 10, 20, 30 and 40 minutes, with the experiment halted by the addition of paraformaldehyde (PFA) to a final concentration of 1%. After adding the fixative, samples were brought onto 0.2 µm polycarbonate filters which were suspended in 3-5 mL scintillation cocktail (Goldstar) to be measured with the on-board liquid scintillation counter the next day. Samples were saved for optional later reanalysis on more sensitive equipment.
Respiration of ^{14}C-Leucine was also measured after Hill et al., 2013. For these assays 0.4 nM ^{14}C-Leucine was added to 6-8 70 mL subsample replicates in gas-tight borosilicate glass bottles. These were allowed to respire in a dark incubator, which was set to either the sea surface temperature when all depths were sampled, or the DCM temperature where only the DCM was sampled. Respiration was halted at regular intervals between 6-12 hours via the addition of 1 mL HCl 10% v/v. Typically, the next day, samples were harvested by passing through CO_2-scrubbed air and trapping the respired $^{14}CO_2$ in 4 mL sorbent (Carbo-Sorb E) in a scintillation vial. 15 mL of scintillation cocktail was added to

the sorbent, and samples were counted on-board the next day, and saved for optional reanalysis at the home lab.

Samples for DOM were collected at the same time and depths as respiration and production samples, as well as from two deep casts in the North Atlantic Gyre and the South Atlantic Gyre. Regular pre-dawn CTD samples were filtered (~1500 mL) over ashed GF/F filters using HCl-washed equipment concurrently with the bacterial production and respiration assays. The filtrate (1 L) was acidified to a pH of 2 using concentrated HCl (Suprapur grade, Merck) and stored at 4 °C in the dark until extraction. Deep cast samples were filtered in concurrent batches of 3 depths (7-8 L each depth), prioritising surface samples with waiting samples stored at 4 °C in the dark, which were similarly acidified and extracted directly after.
All filters were saved, flash-frozen in liquid nitrogen and stored at -80 °C. Solid phase extraction was performed using 200 mg Bond Elut columns (Agilent) for the regular predawn CTD samples and 1 g columns for the high volume samples from the deep casts. The acidified samples were pulled through the cartridges which were subsequently eluted with 1-3 mL methanol, collected in glass vials and stored at -20 °C, with long-term storage northbound at -80 °C.

Concurrently with the above main assays and extractions, abundance samples were taken from our carboys immediately after sampling the CTD: duplicates of 1 mL fixed with 0.5% glutaraldehyde and 1% PFA (4 samples per depth). Samples for molecular analysis (1.6 mL) were also collected immediately, two non-fixed and two fixed with 1% PFA. All samples were flash-frozen in liquid nitrogen and stored at -80 °C.

Reference

Hill, P. G., Warwick, P. E., & Zubkov, M. V. (2013). Low microbial respiration of leucine at ambient oceanic concentration in the mixed layer of the central Atlantic Ocean. *Limnology and Oceanography*, *58*(5), 1597–1604. https://doi.org/10.4319/lo.2013.58.5.1597

Table 1: Samples collected from CTD rosette sampler

Properties listed:

P bacterial production
R bacterial respiration
D dissolved organic matter
C enumeration
M molecular

Date	Time	Station No.	CTD cast	Lat (+ve N)	Lon (+ve E)	Depths sampled (m)	Properties
27/09/2018	0334	2	002	48.51	-8.89	5, 20, 60	P, R, D, C
28/09/2018	0337	6	006	42.98	-15.22	52	P, R, D, C
29/09/2018	0334	8	008	37.76	-17.97	5, 17, 71	P, R, D, C
30/09/2018	0337	10	010	36.63	-20.20	105	P, R, D, C
01/10/2018	0338	12	012	33.26	-22.19	5, 22, 90	P, R, D, C
02/10/2018	0338	14	014	29.57	-24.18	114	P, R, D, C
02/10/2018	1050	15	015	28.62	-24.37	5, 50, 135, 250, 500, 1000, 2000, 3000, 4000	D, C, M

05/10/2018	0428	20	020	19.25	-28.48	5, 22, 90	P, R, D, C, M
06/10/2018	0438	22	022	15.22	-28.81	57	P, R, D, C, M
07/10/2018	0437	24	024	11.66	-27.85	5, 12, 50	P, R, D, C, M
08/10/2018	0438	27	026	7.21	-26.65	72	P, R, D, C, M
09/10/2018	0439	29	028	3.93	-25.87	89	P, R, D, C, M
10/10/2018	0446	30	029	0.01	-25.25	5, 14, 60	P, R, D, C, M
11/10/2018	0430	32	031	-3.81	-25.16	60	P, R, D, C, M
12/10/2018	0439	34	033	-7.79	-25.07	5, 26, 110	P, R, D, C, M
13/10/2018	0435	36	035	-11.46	-25.00	122	P, D, C, M
13/10/2018	1033	37	036	-12.09	-24.94	5, 50, 111, 250, 500, 1000, 2000, 3000, 4000	D, C, M
14/10/2018	0435	38	037	-14.78	-24.99	5, 35, 145	D, C, M
16/10/2018	0419	43	040	-20.58	-24.21	5, 40, 161	P, R, D, C, M
17/10/2018	0435	45	042	-24.25	-25.25	140	P, R, D, C, M
18/10/2018	0443	47	044	-26.81	-27.73	5, 30, 127	P, R, D, C, M
19/10/2018	0436	49	046	-29.30	-30.33	130	P, R, D, C, M
20/10/2018	0445	51	048	-31.65	-32.90	5, 31, 131	P, R, D, C, M
21/10/2018	0440	53	050	-34.07	-35.30	80	P, R, D, C, M
22/10/2018	0445	55	052	-36.18	-38.12	5, 17, 70	P, R, D, C, M
24/10/2018	0440	59	056	-40.59	-43.34	5, 10, 40	P, R, D, C, M
25/10/2018	0540	61	058	-43.10	-46.22	55	P, R, D, C, M
26/10/2018	0538	63	060	-45.52	-49.10	5, 13, 53	P, R, D, C, M

REMINERALISATION OF ORGANIC CARBON BY MARINE BACTERIOPLANKTON (REMAIN) – REDUCING THE KNOWN UNKNOWN

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Cruise Objectives

1. To determine the relationship between plankton respiration derived from dissolved oxygen consumption (CR_{O2}) and the reduction of a tetrazolium salt (2-para(indophenol)-3(nitrophenyl)-5(phenyl) tetrazolium chloride-INT) (INT_R) across a range of plankton communities and environmental conditions
2. To determine the influence of plankton community structure and the stoichiometry of dissolved organic matter (DOM) on the relationship between CR_{O2} and INT_R
3. To determine the proportion of plankton community respiration attributable to the 0.1-0.8 µm and 0.8-2.0 µm size classes using INT_R and ETS and assess how this is influenced by environmental conditions
4. To determine size fractionated plankton respiration for the first time using both the classical ETS method and a new enzyme kinetic model (EKM) incorporating pyridine nucleotide concentrations
5. To determine zooplankton respiration
6. To compare our 4 methods of measuring plankton respiration with the ^{14}C-leucine technique used by project partner Claire Evans' group (NOC)
7. In collaboration with the NOC group, derive bacterial growth efficiencies and assess any influence of DOM stoichiometry
8. Measure dissolved oxygen in order to calibrate the CTD oxygen sensor
9. To communicate the importance of plankton respiration, and especially bacterioplankton respiration, to the general public via social media (cruise blog, twitter, SWAY), articles in popular magazines and through contribution to the 2018 Global Science Opera (http://globalscienceopera.com/) on the ocean

Methods

Community respiration derived from in vitro changes in dissolved oxygen concentration (CR_{O2})

CR_{O2} was determined as the decrease in dissolved oxygen concentration of a water sample incubated in the dark for 24 h (Robinson et al., 2002; Serret et al., 2015). Water samples were collected into 10 L carboys from each of six depths from the pre-dawn CTD cast (~04:30 GMT) corresponding to 5 m, the depth at which irradiance is 33% of surface irradiance, the depth of 14% of surface irradiance, the depth of the deep chlorophyll maximum (DCM), 10 m below the DCM and 200 m. Ten gravimetrically calibrated ~55 mL glass bottles were carefully filled with water from each depth. Five bottles were fixed at the start of the incubation ("zero time samples") with 0.5 mL of manganese sulphate and 0.5 mL of a solution of sodium iodide/sodium hydroxide. The other five bottles were placed in water temperature controlled incubators for 24 hours ("dark samples"). The incubation temperatures were ±1 °C of the *in situ* temperature. Bottles were removed from the incubators after 24 hours and fixed with $MnSO_4$ and NaI/NaOH. Dissolved oxygen concentration was measured by automated precision Winkler titration using a Metrohm 765 Dosimat titrator to a photometric end point (Carritt & Carpenter, 1966). All bottles were analysed within 36 hours. Plankton community respiration was calculated as the difference in oxygen concentration between the means of the "zero" and "dark" measurements. 25 profiles were completed as detailed in Table 1 below.

Community and size fractionated respiration derived from the reduction of INT (INT_R).

Water samples were collected from the same six depths as CR_{O2}. Five dark glass bottles were filled with 240 mL from each 10 L carboy. Two replicates were fixed immediately by adding 6 mL of formaldehyde (2% w/v final concentration) and used as killed controls. Twenty minutes later all five replicates were inoculated with 6 mL of a sterile solution of 7.9 mM 2-(ρ-iodophenyl)-3-(ρ-nitrophenyl)-5phenyl tetrazolium salt (INT) to give a final concentration of 0.2 mM. The solution was freshly prepared for each experiment using Milli-Q water. Samples were incubated in the same temperature-controlled water baths as for CR_{O2} for between 30 minutes and 3 hours and then fixed by adding formaldehyde, as for the killed controls. After 20 minutes, the samples were sequentially filtered through 2.0, 0.8 and onto 0.1 µm pore size polycarbonate filters. The filters were then stored frozen in 1.5 mL cryovials at –80°C until return to UEA. The CR_{INT} (i.e. the sum of respiration of the >2.0 µm, 0.8 – 1.0 µm and 0.1-0.8 µm fractions) and BR_{INT} (considered as the respiration of the 0.1-0.8 µm fraction) will be measured following Martínez-García et al. (2009).

Time-course experiments were carried out in each biogeochemical province in order to know the optimal incubation time range for the experiments in that province. Samples were also collected for flow cytometric analysis from the surface (5 m depth), DCM and 200 m. The analysis of the communities in the experimental size fractions was undertaken by Rebecca May (Plymouth Marine Laboratory). See Table 1 of samples collected.

Community and size fractionated respiration measured with the classical ETS method

Water samples were collected into 10 L carboys from Niskin bottles fired at the same six depths (surface, 33% light, 14% light, deep chlorophyll maximum, 10 m below the DCM and 200 m) as CR_{O2} and INT_R. The carboys were flushed twice with the sample seawater and immediately placed in the 4 ºC constant temperature room. Approximately 10 L of seawater from each depth was filtered through 3 pore size filters (2.0 µm, 0.8 µm and 0.1 µm), thus allowing the estimation of the contribution of each component of the plankton community to the total respiration. Once the filtration was completed, the volume was measured with a 2 L measuring cylinder. The filters were snap-frozen in liquid nitrogen (-196 ºC) and stored at -80 ºC. Samples will be shipped by dry shipper to Concepción for subsequent kinetic analyses of the electron transport activity (ETS) following the Owens and King (1975) protocol. See Table 1 for a list of samples collected.

Community and size fractionated respiration derived from pyridine nucleotide concentrations and an enzyme kinetic model.

The same procedure as that described for the classical ETS method was followed. In this case, however, the filters will be analysed for the intracellular concentration of pyridine nucleotides (Wagner and Scott, 1994) in order to apply a kinetic model that uses the potential respiratory activity (ETS), kinetic enzymatic constants and the concentration of intracellular substrates to estimate actual respiratory rates. See Table 1 for a list of samples collected.

Zooplankton respiration

Zooplankton were collected at pre-dawn by vertical tows with a Bongo net (57 cm diameter ring, fitted with 120 µm and 200 µm mesh sizes) either from 200 or 250 m to the surface. The hauling speed was about 0.2–0.3 m s^{-1}, as recommended for physiological studies of live zooplankton. The samples from the 120 µm mesh size were split by the beaker technique; one half was fractionated for incubation experiments (Llopis-Monferrer et al., this cruise), while the other was carefully fractionated into 100–500 µm, 500–2000 µm and >2000 µm size categories, and immediately frozen in liquid nitrogen before being stored in the freezer (−80 °C) for subsequent enzymatic (classical ETS) and stable isotope (C and N) analyses. Organisms collected by the 200 µm mesh size net were stored in plastic bottles filled with buffered formaldehyde for taxonomic analysis (Tarran et al., this cruise). See Table 2 for a list of nets sampled.

Particulate organic carbon and nitrogen and isotopic analysis

~20 L of surface seawater was collected at predawn from the underway non toxic seawater system for analysis of POC and PON concentrations, as well as the isotopic signatures (^{13}C and ^{15}N) in seston as a baseline for zooplankton values. Accordingly, all underway samples were taken at the same stations as those for zooplankton (see Table 2). 5 L was filtered through GF/F filters for POM concentration; 15 L was filtered through 0.8 µm polycarbonate filters for specific isotopic measurements of amino acids.

Dissolved organic carbon, total dissolved nitrogen and dissolved organic phosphorus (DOC, TDN & DOP)

Water for dissolved organic carbon, nitrogen and phosphorous (DOC/N/P) was collected from four depths at all pre-dawn CTDs where CR_{O2} and INT_R were measured (see Table 1) and filtered according to the protocol described in Margolin et al. (2015). The depths corresponded to the surface (5 m), Deep Chlorophyll Maximum (DCM), 10 m below the DCM and 200 m. Collection bottles were rinsed with sample water and 1 litre of water was subsequently collected from each depth and stored at 4°C until filtering. All bottles and filtration equipment were acid-washed in a 10% HCl bath for at least 6 hours, rinsed thoroughly (at least 3 times) in Milli-Q and left to air dry in a clean fume hood. Water was filtered through a 0.45 µm pre-combusted GF/F and stored in labelled bottles at -20 °C until return to UEA.

Chlorophyll concentration

Chlorophyll-a (chl-a) was measured as an indicator of phytoplankton biomass. 1 L of seawater was collected at the predawn cast at all stations where either CR_{O2}, INT_R or ETS samples were collected (see Table 1). Between 250 and 500 mL of seawater was filtered through the 0.2 µm polycarbonate filters depending on the productivity of the system. The filters were first stored at -20 ºC before pigment extraction. Pigments were then extracted in acetone for 24 h, and their concentration was determined onboard using their fluorescence properties as described by Yentsch and Menzel (1963).

16S and 18S rRNA

Water samples were collected from all CTDs where CR_{O2} and INT_R were measured (see Table 1) at two depths corresponding to the surface (5 m) and the DCM. Four litres of water were collected into pre-rinsed carboys and filtered within ~1 hour through a 0.22 µm Sterivex filter connected between the carboy and peristaltic pump with silicone tubing. To minimise degradation of the material, the water was filtered in the 2-4 °C controlled temperature room. Between 1 and 4 litres of water were filtered, depending on the productivity of the region. At the end of filtering, the Sterivex was sealed at both ends with Parafilm and stored in the -80 °C freezer until return to UEA.

Microscopy

Water samples were collected for plankton analysis in two ways. Firstly, 200 mL water was collected directly from the CTD from two depths corresponding to the surface (5 m) and the DCM. This was fixed immediately with Lugol's iodine solution using a concentration of 2 mL Lugol's per 100 mL sample. Secondly, 11 litres of water were collected from the same two depths and reverse-filtered through a 20 µm mesh in order to retain a concentrated sample of ~200 mL with plankton >20 µm. This was fixed with Lugol's iodine solution using a concentration of 3 mL per 100 mL sample. The bottles were sealed with parafilm and stored in the cool stow until return to the UK and analysis by project partner Claire Widdicombe at Plymouth Marine Laboratory.

Calibration of the CTD oxygen sensor

Samples were collected from 6 depths (surface, 33% light depth, 14% light depth, depth of the deep chlorophyll maximum (DCM), 10 m below the DCM and 200 m) on the pre-dawn CTD. Additional samples were taken when available at the oxygen minimum and below 200 m. One or two 55 mL glass bottles were filled directly from the Niskin bottle following Langdon, 2010. Samples were fixed immediately with $MnSO_4$ and NaI/NaOH and analysed within 36 hours. Measurements of dissolved oxygen were made using an automated Winkler titration system to a photometric endpoint (Williams and Jenkinson, 1982). The sodium thiosulphate titrant was calibrated every second day before the analysis of the samples and the coefficient of variation of the calibration was always <0.3% (Langdon, 2010). In total, 36 profiles were analysed for the oxygen sensor calibration covering a concentration range between 66 and 294 µmol per L.

Provisional results

Calibration of the CTD oxygen sensor

Winkler oxygen data will be used to calibrate the SBE oxygen sensor on the CTD. Provisional data show a good relationship between the sensor and Winkler titrations. All data above 200 m are shown in Figure 1. The offset between the two varied with time (CTD number) and oxygen concentration (Figure 2). Samples collected below 200 m will be used to assess whether the relationship varies with depth (pressure).

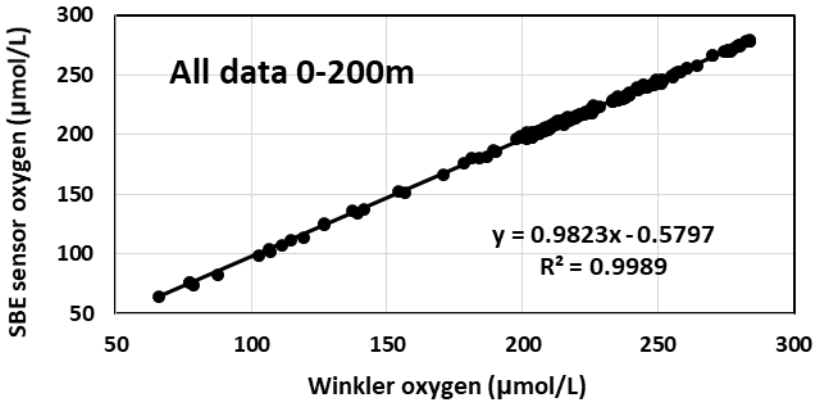

Figure 1 Regression between SBE sensor oxygen and Winkler oxygen

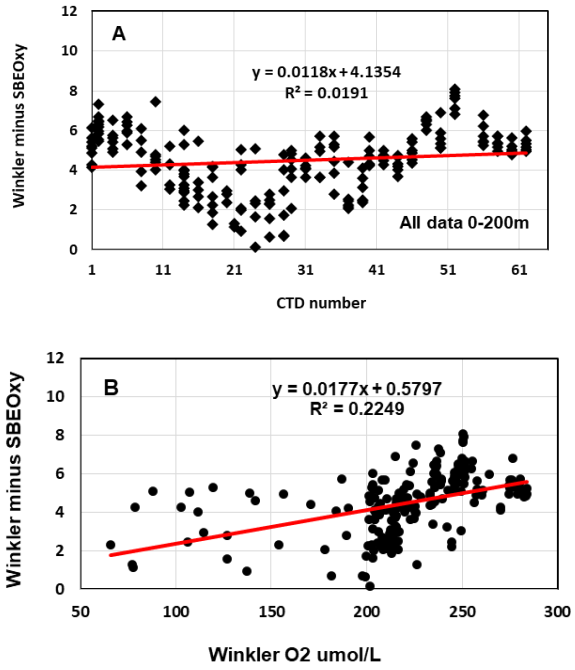

Figure 2 The offset (µmol /L) between the SBE sensor and Winkler oxygen varied with time (A) and oxygen concentration (B)

Acknowledgements

Many thanks to the officers, crew and Principal Scientist for all their help during the cruise. Thank you to Rebecca May (Plymouth Marine Laboratory) for AFC analysis and John R. Ballard (University of San Diego) for inorganic nitrogen analysis. Thank you to Elena Garcia-Martin (UEA) and Natalia Osma (University of Concepción) for all their help in preparing for the cruise.

This study was supported by funds from The Leverhulme Trust [grant RPG-2017-089 awarded to C.R.] and the U.K. Natural Environment Research Council (NERC) [grants NE/R000956/1 and NE/K00168X/1 awarded to C.R.]. Igor Fernández was supported by a Postdoctoral Project (No. 3180352) granted from the National Program for Scientific and Technological Development (FONDECYT-CONICYT) from the Chilean Government.

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Table 1: CTD samples collected

Date	Time (GMT)	CTD Cast	LAT (+ve N)	LON (+ve E)	Niskins sampled	Parameters
25/09/2018	12:32	1	49.6381	-5.50158	21	INT_R time series plus flow cytometric analysis of size fractions
25/09/2018	12:32	1	49.6381	-5.50158	1, 10, 16, 21	Dissolved O_2, DOC, DON, DOP
25/09/2018	12:32	1	49.6381	-5.50158	2, 8, 12, 15, 18, 23	ETS
25/09/2018	12:32	1	49.6381	-5.50158	1, 7, 11, 14, 17, 22	Chl
25/09/2018	12:32	1	49.6381	-5.50158	17, 22	RNA
25/09/2018	12:32	1	49.6381	-5.50158	17, 22	Lugols
26/09/2018	03:34	2	48.46939	-8.83656	1, 4, 6, 13, 17, 20	Dissolved O_2, CR_{O2}, INT_R, Chl
26/09/2018	03:34	2	48.46939	-8.83656	2, 5, 8, 14, 18, 21	ETS, EKM
26/09/2018	03:34	2	48.46939	-8.83656	1, 4, 6, 20	DOC, DON, DOP
26/09/2018	03:34	2	48.46939	-8.83656	6, 20	RNA
26/09/2018	03:34	2	48.46939	-8.83656	9, 20, 23	Lugols
27/09/2018	03:30	4	46.0291	-12.73255	1, 4, 6, 13, 17, 20	Dissolved O_2, CR_{O2}, INT_R, Chl
27/09/2018	03:30	4	46.0291	-12.73255	20	INT_R time series plus flow cytometric analysis of size fractions
27/09/2018	03:30	4	46.0291	-12.73255	2, 5, 8, 14, 17, 21	ETS, EKM
27/09/2018	03:30	4	46.0291	-12.73255	1, 4, 6, 20	DOC, DON, DOP

27/09/2018	03:30	4	46.0291	-12.73255	6, 20	RNA
27/09/2018	03:30	4	46.0291	-12.73255	9, 23	Lugols
28/09/2018	03:33	6	42.96752	-15.21344	2, 5, 8, 15, 18, 21	Dissolved O_2
28/09/2018	03:33	6	42.96752	-15.21344	3, 6, 9, 16, 19, 22	ETS, Chl
29/09/2018	03:29	8	39.71934	-17.71619	1, 4, 7, 13, 17, 20	Dissolved O_2, CR_{O2}, INT_R, Chl
29/09/2018	03:29	8	39.71934	-17.71619	2, 5, 8, 14, 18, 21	ETS, EKM
29/09/2018	03:29	8	39.71934	-17.71619	1, 4, 7, 20	DOC, DON, DOP
29/09/2018	03:29	8	39.71934	-17.71619	7, 20	RNA
29/09/2018	03:29	8	39.71934	-17.71619	9, 23	Lugols
30/09/2018	04:27	10	36.41392	-20.12145	1, 4, 7, 14, 16, 21	Dissolved O_2, CR_{O2}, INT_R, Chl
30/09/2018	04:27	10	36.41392	-20.12145	20, 21	INT_R time series plus flow cytometric analysis of size fractions
30/09/2018	04:27	10	36.41392	-20.12145	2, 5, 8, 15, 17, 22	ETS, EKM
30/09/2018	04:27	10	36.41392	-20.12145	1, 4, 7, 21	DOC, DON, DOP
30/09/2018	04:27	10	36.41392	-20.12145	7, 21	RNA
30/09/2018	04:27	10	36.41392	-20.12145	9, 23	Lugols
01/10/2018	04:30	12	33.04696	-22.13676	1, 4, 6, 13, 17, 22	Dissolved O_2
01/10/2018	04:30	12	33.04696	-22.13676	2, 5, 7, 14, 18, 23	ETS, Chl
02/10/2018	04:34	14	29.48832	-23.93246	1, 5, 8, 15, 17, 21	Dissolved O_2, CR_{O2}, INT_R, Chl
02/10/2018	04:34	14	29.48832	-23.93246	2, 6, 9, 16, 18, 22	ETS, EKM
02/10/2018	04:34	14	29.48832	-23.93246	1, 5, 8, 21	DOC, DON, DOP
02/10/2018	04:34	14	29.48832	-23.93246	8, 21	RNA
02/10/2018	04:34	14	29.48832	-23.93246	10, 23	Lugols
03/10/2018	04:32	16	26.20378	-25.52107	1, 4, 7, 15, 17, 21	Dissolved O_2, CR_{O2}, INT_R, Chl
03/10/2018	04:32	16	26.20378	-25.52107	2, 5, 8, 16, 18, 22	ETS, EKM
03/10/2018	04:32	16	26.20378	-25.52107	1, 4, 7, 21	DOC, DON, DOP
03/10/2018	04:32	16	26.20378	-25.52107	7, 21	RNA
03/10/2018	04:32	16	26.20378	-25.52107	9, 23	Lugols

04/10/2018	04:34	18	22.59968	-27.21334	1, 7, 9, 15, 17, 21	Dissolved O_2, CR_{O2}, INT_R, Chl
04/10/2018	04:34	18	22.59968	-27.21334	2, 8, 10, 16, 18, 22	ETS, EKM
04/10/2018	04:34	18	22.59968	-27.21334	1, 7, 9, 21	DOC, DON, DOP
04/10/2018	04:34	18	22.59968	-27.21334	9, 21	RNA
04/10/2018	04:34	18	22.59968	-27.21334	11, 23	Lugols
05/10/2018	04:36	20	19.07775	-28.81675	1, 4, 7, 13, 16, 21	Dissolved O_2, CR_{O2}, INT_R, Chl
05/10/2018	04:36	20	19.07775	-28.81675	21	INT_R time series plus flow cytometric analysis of size fractions
05/10/2018	04:36	20	19.07775	-28.81675	2, 4, 8, 14, 17, 22	ETS, EKM
05/10/2018	04:36	20	19.07775	-28.81675	1, 4, 7, 21	DOC, DON, DOP
05/10/2018	04:36	20	19.07775	-28.81675	7, 21	RNA
05/10/2018	04:36	20	19.07775	-28.81675	9, 23	Lugols
06/10/2018	04:37	22	15.07608	-28.61262	1, 7, 11, 16, 19, 22	Dissolved O_2
06/10/2018	04:37	22	15.07608	-28.61262	2, 8, 12, 17, 20, 23	ETS, Chl
07/10/2018	04:35	24	11.44698	-27.70872	1, 5, 8, 13, 17, 21	Dissolved O_2, CR_{O2}, INT_R, Chl
07/10/2018	04:35	24	11.44698	-27.70872	2, 6, 9, 14, 18, 22	ETS, EKM
07/10/2018	04:35	24	11.44698	-27.70872	1, 5, 8, 21	DOC, DON, DOP
07/10/2018	04:35	24	11.44698	-27.70872	8, 21	RNA
07/10/2018	04:35	24	11.44698	-27.70872	10, 23	Lugols
08/10/2018	04:36	26	7.47128	-26.65012	1, 5, 8, 14, 17, 21	Dissolved O_2, CR_{O2}, INT_R, Chl
08/10/2018	04:36	26	7.47128	-26.65012	20, 21	INT_R time series plus flow cytometric analysis of size fractions
08/10/2018	04:36	26	7.47128	-26.65012	2, 6, 9, 15, 18, 22	ETS, EKM
08/10/2018	04:36	26	7.47128	-26.65012	1, 5, 8, 21	DOC, DON, DOP
08/10/2018	04:36	26	7.47128	-26.65012	8, 21	RNA
08/10/2018	04:36	26	7.47128	-26.65012	10, 23	Lugols
09/10/2018	04:38	28	3.80776	-25.8358	1, 5, 8, 15, 17, 21	Dissolved O_2
09/10/2018	04:38	28	3.80776	-25.8358	2, 6, 9, 16, 18, 22	ETS, Chl

10/10/2018	04:42	29	0.00056	-24.99909	1, 5, 8, 13, 17, 20	Dissolved O_2, CR_{O2}, INT_R, Chl
10/10/2018	04:42	29	0.00056	-24.99909	2, 6, 9, 14, 18, 21	ETS, EKM
10/10/2018	04:42	29	0.00056	-24.99909	1, 5, 8, 20	DOC, DON, DOP
10/10/2018	04:42	29	0.00056	-24.99909	8, 20	RNA
10/10/2018	04:42	29	0.00056	-24.99909	10, 23	Lugols
11/10/2018	04:37	31	-3.69158	-24.97764	1, 6, 9, 15, 18, 21	Dissolved O_2, CR_{O2}, INT_R, Chl
11/10/2018	04:37	31	-3.69158	-24.97764	2, 7, 10, 16, 19, 22	ETS, EKM
11/10/2018	04:37	31	-3.69158	-24.97764	1, 6, 9, 21	DOC, DON, DOP
11/10/2018	04:37	31	-3.69158	-24.97764	9, 21	RNA
11/10/2018	04:37	31	-3.69158	-24.97764	11, 21, 23	Lugols
12/10/2018	04:37	33	-7.54874	-24.95725	1, 5, 8, 13, 16, 20	Dissolved O_2, CR_{O2}, INT_R, Chl
12/10/2018	04:37	33	-7.54874	-24.95725	8	INT_R time series plus flow cytometric analysis of size fractions
12/10/2018	04:37	33	-7.54874	-24.95725	2, 6, 9, 14, 17, 22	ETS, EKM
12/10/2018	04:37	33	-7.54874	-24.95725	1, 5, 8, 20	DOC, DON, DOP
12/10/2018	04:37	33	-7.54874	-24.95725	8, 20	RNA
12/10/2018	04:37	33	-7.54874	-24.95725	10, 20, 23	Lugols
13/10/2018	04:33	35	-11.26239	-24.9374	1, 4, 7, 14, 17, 21	Dissolved O_2, CR_{O2}, INT_R, Chl
13/10/2018	04:33	35	-11.26239	-24.9374	2, 5, 8, 15, 18, 22	ETS, EKM
13/10/2018	04:33	35	-11.26239	-24.9374	1, 4, 7, 21	DOC, DON, DOP
13/10/2018	04:33	35	-11.26239	-24.9374	7, 21	RNA
13/10/2018	04:33	35	-11.26239	-24.9374	9, 21, 23	Lugols
14/10/2018	04:33	37	-14.77977	-24.98475	1, 4, 7, 13, 17, 21	Dissolved O_2, CR_{O2}, INT_R, Chl
14/10/2018	04:33	37	-14.77977	-24.98475	20, 21	INT_R time series plus flow cytometric analysis of size fractions
14/10/2018	04:33	37	-14.77977	-24.98475	2, 5, 8, 14, 18, 22	ETS, EKM
14/10/2018	04:33	37	-14.77977	-24.98475	1, 4, 7, 21	DOC, DON, DOP
14/10/2018	04:33	37	-14.77977	-24.98475	7, 21	RNA

14/10/2018	04:33	37	-14.77977	-24.98475	9, 21, 23	Lugols
15/10/2018	04:33	39	-18.33931	-25.08566	1, 5, 7, 16, 19, 22	Dissolved O_2
15/10/2018	04:33	39	-18.33931	-25.08566	2, 6, 8, 17, 20, 23	ETS, Chl
16/10/2018	04:37	40	-20.37933	-25.05943	1, 4, 6, 12, 16, 21	Dissolved O_2, CR_{O2}, INT_R, Chl
16/10/2018	04:37	40	-20.37933	-25.05943	6	INT_R time series plus flow cytometric analysis of size fractions
16/10/2018	04:37	40	-20.37933	-25.05943	2, 5, 7, 13, 17, 22	ETS, EKM
16/10/2018	04:37	40	-20.37933	-25.05943	1, 4, 6, 21	DOC, DON, DOP
16/10/2018	04:37	40	-20.37933	-25.05943	6, 21	RNA
16/10/2018	04:37	40	-20.37933	-25.05943	8, 21, 23	Lugols
17/10/2018	04:28	42	-23.99954	-24.99934	1, 5, 8, 15, 18, 21	Dissolved O_2, CR_{O2}, INT_R, Chl
17/10/2018	04:28	42	-23.99954	-24.99934	2, 6, 9, 16, 19, 22	ETS, EKM
17/10/2018	04:28	42	-23.99954	-24.99934	1, 5, 8, 21	DOC, DON, DOP
17/10/2018	04:28	42	-23.99954	-24.99934	8, 21	RNA
17/10/2018	04:28	42	-23.99954	-24.99934	10, 21, 23	Lugols
18/10/2018	04:40	44	-26.62798	-27.65536	1, 4, 6, 12, 16, 21	Dissolved O_2, CR_{O2}, INT_R, Chl
18/10/2018	04:40	44	-26.62798	-27.65536	2, 5, 7, 13, 17, 22	ETS, EKM
18/10/2018	04:40	44	-26.62798	-27.65536	1, 4, 6, 21	DOC, DON, DOP
18/10/2018	04:40	44	-26.62798	-27.65536	6, 21	RNA
18/10/2018	04:40	44	-26.62798	-27.65536	8, 21, 23	Lugols
19/10/2018	04:34	46	-29.1276	-30.22349	1, 4, 7, 14, 17, 21	Dissolved O_2, CR_{O2}, INT_R, Chl
19/10/2018	04:34	46	-29.1276	-30.22349	2, 5, 8, 15, 18, 22	ETS, EKM
19/10/2018	04:34	46	-29.1276	-30.22349	1, 4, 7, 21	DOC, DON, DOP
19/10/2018	04:34	46	-29.1276	-30.22349	7, 21	RNA
19/10/2018	04:34	46	-29.1276	-30.22349	9, 21, 23	Lugols
20/10/2018	04:40	48	-31.61847	-32.88412	1, 4, 6, 12, 16, 21	Dissolved O_2, CR_{O2}, INT_R, Chl
20/10/2018	04:40	48	-31.61847	-32.88412	2, 5, 7, 13, 17, 22	ETS, EKM
20/10/2018	04:40	48	-31.61847	-32.88412	1, 4, 6, 21	DOC, DON, DOP

20/10/2018	04:40	48	-31.61847	-32.88412	6, 21	RNA
20/10/2018	04:40	48	-31.61847	-32.88412	8, 21, 23	Lugols
21/10/2018	04:36	50	-33.83179	-35.26906	1, 6, 9, 16, 18, 21	Dissolved O_2, CR_{O2}, INT_R, Chl
21/10/2018	04:36	50	-33.83179	-35.26906	2, 7, 10, 17, 19, 22	ETS, EKM
21/10/2018	04:36	50	-33.83179	-35.26906	1, 6, 9, 21	DOC, DON, DOP
21/10/2018	04:36	50	-33.83179	-35.26906	9, 21	RNA
21/10/2018	04:36	50	-33.83179	-35.26906	11, 21, 23	Lugols
21/10/2018	13:07	51	-34.58054	-36.09145	1, 6, 8, 11	Dissolved O_2
22/10/2018	04:40	52	-36.16738	-37.86655	1, 5, 7, 13, 17, 21	Dissolved O_2, CR_{O2}, INT_R, Chl
22/10/2018	04:40	52	-36.16738	-37.86655	21, 24	INT_R time series plus flow cytometric analysis of size fractions
22/10/2018	04:40	52	-36.16738	-37.86655	2, 6, 8, 14, 18, 22	ETS, EKM
22/10/2018	04:40	52	-36.16738	-37.86655	1, 5, 7, 21	DOC, DON, DOP
22/10/2018	04:40	52	-36.16738	-37.86655	7, 21	RNA
22/10/2018	04:40	52	-36.16738	-37.86655	9, 21, 23	Lugols
23/10/2018	13:06	55	-39.2093	-41.47502	1, 3, 6, 9, 11, 12, 13, 14	Dissolved O_2
24/10/2018	04:36	56	-40.521	-43.0831	1, 5, 7, 14, 17, 21	Dissolved O_2, CR_{O2}, INT_R, Chl
24/10/2018	04:36	56	-40.521	-43.0831	2, 6, 8, 15, 18, 22	ETS, EKM
24/10/2018	04:36	56	-40.521	-43.0831	1, 5, 7, 21	DOC, DON, DOP
24/10/2018	04:36	56	-40.521	-43.0831	7, 21	RNA
24/10/2018	04:36	56	-40.521	-43.0831	9, 21, 23	Lugols
24/10/2018	13:02	57	-40.521	-43.0831	1, 3, 6, 9, 11, 14	Dissolved O_2
25/10/2018	05:37	58	-43.006	-45.9817	1, 7, 10, 15, 18, 21	Dissolved O_2, CR_{O2}, INT_R, Chl
25/10/2018	05:37	58	-43.006	-45.9817	2, 8, 11, 16, 19, 22	ETS, EKM
25/10/2018	05:37	58	-43.006	-45.9817	1, 7, 10, 21	DOC, DON, DOP
25/10/2018	05:37	58	-43.006	-45.9817	10, 21	RNA
25/10/2018	05:37	58	-43.006	-45.9817	12, 21, 23	Lugols
26/10/2018	05:35	60	-46.0176	-49.8723	1, 4, 6, 12, 16, 21	Dissolved O_2, CR_{O2}, INT_R, Chl

26/10/2018	05:35	60	-46.0176	-49.8723	19	INT_R time series plus flow cytometric analysis of size fractions
26/10/2018	05:35	60	-46.0176	-49.8723	2, 5, 7, 13, 17, 22	ETS, EKM
26/10/2018	05:35	60	-46.0176	-49.8723	1, 4, 6, 21	DOC, DON, DOP
26/10/2018	05:35	60	-46.0176	-49.8723	6, 21	RNA
26/10/2018	05:35	60	-46.0176	-49.8723	8, 21, 23	Lugols
27/10/2018	06:37	62	-47.56184	-51.77396	2, 6, 9, 13, 16, 18	Dissolved O_2

Table 2 Net samples collected

Station	Event	START date/time	Lat	Lon	Depth
2	BONGO01	26/9/18 3:38	48.46937	-8.83657	130
4	BONGO02	27/9/18 3:29	46.02911	-12.73254	200
6	BONGO03	28/9/18 3:35	42.93067	-15.24096	200
8	BONGO04	29/9/18 3:30	39.71934	-17.71618	200
10	BONGO05	30/9/18 4:27	36.41393	-20.12146	200
12	BONGO06	1/10/18 4:27	33.04687	-22.13684	200
14	BONGO07	2/10/18 4:34	29.48831	-23.93245	200
16	BONGO08	3/10/18 4:29	26.20378	-25.52106	200
18	BONGO09	4/10/18 4:27	22.52602	-27.23756	200
20	BONGO10	5/10/18 4:32	19.07778	-28.81673	200
22	BONGO11	6/10/18 4:30	15.07608	-28.61265	200
24	BONGO12	7/10/18 4:31	11.44697	-27.7087	200
27	BONGO13	8/10/18 4:30	7.47128	-26.65011	200
29	BONGO14	9/10/18 4:33	3.80777	-25.83581	200
30	BONGO15	10/10/18 4:44	0.00195	-24.99564	200
32	BONGO16	11/10/18 4:33	-3.6894	-24.97921	200
34	BONGO17	12/10/18 4:36	-7.54858	-24.9588	200
36	BONGO18	13/10/18 4:30	-11.26192	-24.93874	200
38	BONGO19	14/10/18 4:30	-14.77903	-24.98561	250
41	BONGO20	15/10/18 4:33	-18.33901	-25.08716	250
43	BONGO21	16/10/18 4:36	-20.3803	-25.05914	250
45	BONGO22	17/10/18 4:28	-24.00001	-24.99993	250
47	BONGO23	18/10/18 4:34	-26.62795	-27.65536	250
49	BONGO24	19/10/18 4:30	-29.12759	-30.22349	200
51	BONGO25	20/10/18 4:39	-31.61683	-32.88554	200
55	BONGO26	22/10/18 4:29	-36.16649	-37.86574	200
61	BONGO27	25/10/18 5:34	-43.00398	-45.98262	200
63	BONGO28	26/10/18 5:31	-45.29729	-48.89553	200
65	BONGO29	27/10/18 6:34	-47.56557	-51.77405	200

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Silicon Uptake Rates and Silica Content of Rhizaria

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Cruise Objectives

Polycystinean radiolarians and phaeodarians are open-ocean planktonic protozoa which are typified by complex siliceous skeletons. These organisms are distributed worldwide and they can be found from the surface to the abyssal regions. Rhizarians have been extensively studied as a paleoenvironmental tool, however, their physiology and ecology has not been sufficiently investigated because they are hard to cultivate.

The aim of this project is to address the gaps in oceanic field observations and investigate the role of siliceous Rhizaria in the oceanic silica cycle. Herein we collect samples of living Rhizaria to obtain estimates of silica, as well as production rates, from a wide variety of pelagic ecosystems along the Atlantic Ocean transect, to better quantify the contribution of these organisms to the world ocean silica cycle.

Methods

Niskin bottles

Sea water samples were collected every other day at six different depths using Niskin bottles. Silicic acid concentration, particulate organic carbon, nitrogen and biogenic silica content was collected for all depths, while only 3 depths were used for production/incubations.

At each sampling station water was filtered onto a 0.4 µm GF/F filter for organic carbon and nitrogen analyses or onto a 0.8 µm polycarbonate (PC) membrane filter for biogenic silica determination. GF/F filters were frozen at -20°C and PC membranes were stored at room temperature in mini petri dishes until off site analysis.

Net hauls

Plankton samples are collected daily at predawn using a WP-2 bongo (120 µm mesh size/ 63 µm cod-end) vertical haul from 200 m or 250 m to the surface. The sample was divided into 2 subsamples by the beaker technique. One half was frozen for enzymatic analyses (Fernández-Urruzola) and the other half was subsequently split into 4 subsamples.

1. Ethanol fixation for single cell isolation. Sample was sieved through a 44 µm sieve and recovered in a Falcon tube.
2. Acidic lugol fixation for FlowCAM processing. Sample was sieved through a 44 µm sieve and recovered in a glass flask.
3. DNA analysis to be analysed at the SBR (Station Biologique de Roscoff). Sample was quickly filtered through 2 x 47 mm 10 µm PC filters (ca 250 mL each filter). Once filtration was over or whenever it clogged, filters were recovered with cleaned tweezers into two separate 2 mL cryovials.

Samples were immediately flash-frozen in liquid litrogen and stored at -80 °C until further analysis in the lab.

4. Observation for single cell isolation to be used in the production experiments. Small cells were observed under an inverted microscope while largest cells were observed using a stereomicroscope. Siliceous Rhizaria were handpicked and isolated with the aid of a Pasteur pipette and deposited in a 20 mL glass vial with filtered sea water. Cells were sorted according to a few targeted taxonomic groups (Figure 1). Glass vials containing between 1 to 50 cells of the same taxonomic group were incubated on deck, after isolation, for 24h in a flowing-seawater incubator to maintain contstant water temperature.. A series of neutral density screens was used to simulate *in situ* light intensity. After incubation, isotope samples were filtered by gentle (<150mmHg) vacuum filtration onto 47mm diameter, 0.6 µm pore-size polycarbonate membrane filters (Nuclepore) and rinsed twice with filtered seawater to wash away non-particulate ^{32}Si. Each filter was then placed in a clean 20 mL polypropylene liquid scintillation vial and the vial was capped loosely to permit the sample to dry at room temperature for 48 h. The vials were then capped tightly and returned to UBO laboratories for counting using the Cerenkov method. Once the counting is done, digestion will be performed to measure the particulate biogenic silica contained in the filters (BSi).

Provisional Results

The samples taken from the Bongo (zooplankton) and the rosette (seawater) will be analysed back at UBO (France).

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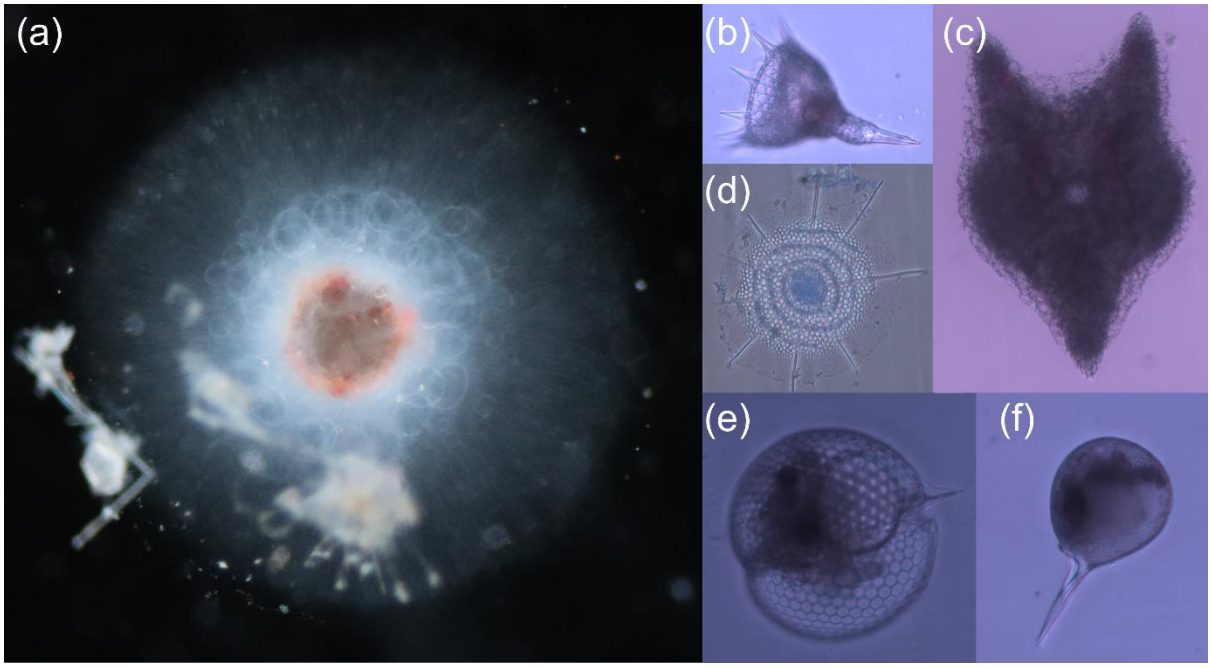

Figure 1. Pictures of the different taxonomic groups taken during the AMT28. (a) Collodaria (*Thalassicolla sp.)*, (b) Nassellaria, (c) and (d) Spumellaria, (e) Phaeoconchida and (f) Phaeogromida

Table 1: AMT28 – CTD samples

Date	Time (GMT)	Station No.	CTD Cast	LAT (+ve N)	LON (+ve E)	Depths sampled (m)
26/09/2018	0334	2	002	48.47	-8.84	140, 70, 60, 25, 10, 5
28/09/2018	0333	6	006	42.97	-15.21	200, 60, 52, 23, 7, 5
30/09/2018	0427	10	010	36.41	-20.12	200, 115, 105, 45, 14, 5
02/10/2018	0434	14	014	29.49	-23.93	200, 124, 114, 45, 15, 5
04/10/2018	0434	18	018	22.60	-27.21	200, 103, 93, 41, 13, 5
06/10/2018	0437	22	022	15.08	-28.61	200, 67, 57, 25, 7, 5
08/10/2018	0436	27	026	7.47	-26.65	200, 82, 72, 30, 9, 5
10/10/2018	0442	30	029	0.00	-24.00	200, 70, 60, 26, 8, 5
12/10/2018	0437	34	033	-7.55	-24.96	200, 120, 110, 47, 15, 5
14/10/2018	0433	38	037	-14.78	-24.98	200, 155, 145, 62, 20, 5
16/10/2018	0437	43	040	-20.39	-25.06	200, 171, 161, 70, 25, 5
18/10/2018	0440	47	044	-26.63	-27.66	200, 137, 127, 56, 17, 5
20/10/2018	0530	51	048	-31.62	-32.88	200, 141, 131, 56, 17, 5
22/10/2018	0440	55	052	-33.17	-37.87	200, 80, 70, 30, 10, 5
24/10/2018	0436	59	056	-40.52	-43.08	200, 50, 40, 17, 8, 5
26/10/2018	0535	63	060	-45.30	-48.90	200, 63, 53, 24, 7, 5

Table 2: AMT28 - Zooplankton samples

Date	Station No.	Bongo No.	Depth sampled (m)	LAT (+ve N)	LON (+ve E)
26/09/2018	2	BONGO01	130	48,47	-8,84
27/09/2018	4	BONGO02	200	46,03	-12,73
28/09/2018	6	BONGO03	200	42,97	-15,21
29/09/2018	8	BONGO04	200	39,72	-17,72
30/09/2018	10	BONGO05	200	36,41	-20,12
01/10/2018	12	BONGO06	200	33,05	-22,14
02/10/2018	14	BONGO07	200	29,49	-23,93
03/10/2018	16	BONGO08	200	26,20	-25,52
04/10/2018	18	BONGO09	200	22,60	-27,21
05/10/2018	20	BONGO10	200	19,08	-28,82
06/10/2018	22	BONGO11	200	15,08	-28,61
07/10/2018	24	BONGO12	200	11,45	-27,71
08/10/2018	27	BONGO13	200	7,47	-26,65
09/10/2018	29	BONGO14	200	3,81	-25,84
10/10/2018	30	BONGO15	200	0,00	-25,00
11/10/2018	32	BONGO16	200	-3,69	-24,98
12/10/2018	34	BONGO17	200	-7,55	-24,96
13/10/2018	36	BONGO18	200	-11,26	-24,94
14/10/2018	38	BONGO19	250	-14,78	-24,98
15/10/2018	41	BONGO20	250	-18,34	-25,09
16/10/2018	43	BONGO21	250	-20,38	-25,06
17/10/2018	45	BONGO22	250	-24,00	-25,00
18/10/2018	47	BONGO23	250	-26,63	-27,66
19/10/2018	49	BONGO24	200	-29,13	-30,22
20/10/2018	51	BONGO25	200	-31,62	-32,88
22/10/2018	55	BONGO26	200	-36,17	-37,87
25/10/2018	61	BONGO27	200	-43,01	-45,98
26/10/2018	63	BONGO28	200	-45,30	-48,90
27/10/2018	65	BONGO29	200	-47,56	-51,77

Genetics, Proteomics and Particulate Organic Matter

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Cruise Objectives

The goal of our work is to link patterns in microbial community structure and growth to nutrient availability and the cycling of organic matter. We propose the following hypotheses:

I. Changes in inorganic nutrient supply and temperature cause C:N:P:O ratios to differ across oceanographic biomes
II. Ambient nutrient conditions significantly influence differences in the population-level genomic structure of microbial communities across the Atlantic Ocean
III. Diel and regional taxa-specific growth rates are highly correlated with particulate organic carbon fluxes

To test these hypotheses, we collected hourly particulate organic matter (POM) samples from the underway system, as well as surface and 50 m genetics samples from CTD casts, along the AMT 28 transect. Additionally, proteomics samples were taken every other day from the underway, concurrent with the pre-dawn CTD cast. The data produced by this research will be analysed using novel quantitative genomics and biogeochemical techniques. Future analyses will compare this data to genomics data generated by our lab from the other three ocean gyres.

Methods

Genetics

Seawater samples were collected approximately every degree of latitude at predawn and solar noon casts, which used a Seabird CTD system containing a 24-bottle rosette of 20 L Niskin bottles, in clean 2 L polycarbonate bottles from 5 m and 50 m depths. A total of 2 L per depth was collected at all stations except the 5 m depth at CTD cast 59 and both depths at CTD cast 62, where 1 L was collected. Water was filtered immediately after collection through a Sterivex 0.22µm filter using a peristaltic pump at a low speed. Once all water was pumped through the Sterivex cartridge, one end was sealed with Crito-seal putty, 1620 µL of sterile ultrapure buffer was pipetted into the filter cartridge, and the other end was sealed with a luer-lok cap. The filters were placed in separate Ziplok bags and preserved frozen at -80^{o}C until shipment to the Dr. Adam Martiny lab at University of California Irvine for further analysis. Final filtration volume was recorded for all samples. Gloves were worn during all steps, and were also used by all samplers at the rosette for the surface bottle 24. A total of 126 genetics samples were collected on the cruise

Prior to the cruise, all silicone tubing, Omnifit caps and cubitainers were cleaned in soapy water, 10% HCL, and Milli-Q water. Once a week 10% bleach solution was run through the tubing for 1 hour, then the tubing was soaked in Milli-Q for 3 hours to sterilize. Between sample collections, the tubing and sample containers were rinsed 4x with Milli-Q water.

Proteomics

Underway seawater samples were collected every other day at 04:30 concurrent with the pre-dawn CTD cast in clean 2 L polycarbonate bottles from a nominal depth of ~5 m. A total of 8 L was collected. Water was filtered immediately after collection through a Sterivex 0.22µm filter using a peristaltic pump at a low speed. Filtration continued until the filter clogged and the final volume was recorded. Once water was pumped through the Sterivex cartridge, one end was sealed with Crito-seal putty, 1620µL of RNAlater buffer was pipetted into the filter cartridge, and the other end was sealed with a luer-lok cap. The filters were placed in separate Ziplok bags and preserved frozen at -80^{o}C until shipment to the Dr. Mak Saito lab at the Woods Hole Oceanographic Institute for further analysis.

Gloves were worn during all steps. Sterilization of equipment was the same as for the genetics samples. At total of 16 proteomics samples were collected on the cruise

Particulate Organic Matter

Particulate organic matter (POM) samples were collected from the underway seawater system for particulate organic carbon (POC), nitrogen (PON), phosphorous (POP) and chemical oxygen demand (COD). The underway seawater system was chosen to increase water volumes and replication. Each sample was pre-filtered through a 30 µm nylon mesh and passed through a GF/F filter (nominal pore size 0.7 µm). An aspirator pump was used to pull water through the filters at a vacuum setting of -0.08 to -0.1 MPa. Between latitudes 49^{o} 38.286' N at 14:00 and 48^{o} 11.921' S at 14:00, a total of 777 underway stations were sampled on the hour. At each station, three carboys were filled with 3-8 L of water (volume biomass-dependent) and designated as POP, POC/PON, or COD. At noon, triplicates of each type of sample were collected. South of 28°N an additional set of samples was collected without a pre-filter. The 13:00 hour and occasionally the 11:00 hour were skipped to allow for noon station set-up and filtration. POP filters were rinsed with 3 mL of buffer to remove traces of dissolved organic phosphorous at the end of filtration. Filters were folded and stored frozen at -20°C in pre-combusted foil squares.

All carboys were rinsed 2x with sample water before collection. GF/F filters and foil squares were pre-combusted at 500°C for 4.5 hours. Prior to the cruise, all silicone tubing, filter holders, and carboys were cleaned in soapy water, 10% HCL, and Milli-Q water. The 30 µm nylon mesh was rinsed with filtered seawater between sample collections. All filters will be shipped frozen and analyzed by the Martiny lab at UC Irvine. Gloves were used for all steps mentioned above.

***Table 1* – CTD casts sampled for microbial community genomic analyses**

Date	TIME (GMT)	Station No.	CTD Cast	Lat	Lon (W)	Depths sampled (m)
25/09/2018	1235	01	01	49º 38.285' N	5º 30.096'	50; 5
26/09/2018	0334	02	02	48º 28.165' N	8º 50.193'	50; 5
26/09/2018	1210	03	03	47º 54.073 N	10º 23.884	50; 5
27/09/2018	0330	04	04	46º 01.745' N	12º 43.950	50; 5
27/09/2018	1207	05	05	44º 58.715' N	13º 35.363	50; 5
28/09/2018	0333	06	06	42º 58.022 N	15º 12.784	50; 5
28/09/2018	1201	07	07	41º54.700' N	16º02.179	50; 5
29/09/2018	0334	08	08	39º 43.158 ' N	17º 42.968'	50; 5
29/09/2018	1200	09	09	38º 37.851' N	18º 31.541'	50; 5
30/09/2018	0436	10	10	36º 24.836' N	20º 07.287'	50; 5
30/09/2018	1259	11	11	35º 18.121' N	20º 54.912'	50; 5
01/10/2018	0438	12	12	33º 2.816' N	22º 08'.206'	50; 5
01/10/2018	1307	13	13	31º 55.442' N	22º 42.611'	50; 5

02/10/2018	0435	14	14	29º 29.299' N	23º 55.948'	50; 5
02/10/2018	1050	15	15	28º 36.544' N	24º 21.650'	50; 5
03/10/2018	0436	16	16	26º 12.227' N	25º 31.264'	50; 5
03/10/2018	1301	17	17	25º 03.461' N	26º 03.408'	50; 5
04/10/2018	0436	18	18	22º 35.980' N	27º 12.800'	50; 5
04/10/2018	1301	19	19	21º 26.830' N	27º 44.720'	50; 5
05/10/2018	0438	20	20	19º 04.664' N	28º 49.004'	50; 5
05/10/2018	1301	21	21	17º 44.837' N	28º 55.814'	50; 5
06/10/2018	0438	22	22	15º 04. 566' N	28º 36.756'	50; 5
06/10/2018	1301	23	23	13º 48.630' N	28º 17.763'	50; 5
07/10/2018	0437	24	24	11º 26.819'N	27º 42.524'	50; 5
07/10/2018	1300	25	25	10º 05.894'N	27º 17.629'	50; 5
08/10/2018	0438	27	26	07º 28.277' N	26º 39.007'	50; 5
08/10/2018	1302	28	27	06º 15.359' N	26º 22.796'	50; 5
09/10/2018	0439	29	28	03º 48.465' N	25º 50.148'	50; 5
10/10/2018	0446	30	29	00º 00.031' S	24º 59.953'	50; 5
10/10/2018	1304	31	30	01º 09.109' S	24º 59.435'	50; 5
11/10/2018	0460	32	31	03º 41.467' S	24º 58.694'	50; 5
11/10/2018	1302	33	32	04º 59.077' S	24º 58.392'	50; 5
12/10/2018	0439	34	33	07º 32.922' S	24º 57.444'	50; 5
12/10/2018	1301	35	34	08º 45.785' S	24º 56.904'	50; 5
13/10/2018	0435	36	35	11º 15.739' S	24º 56.250'	50; 5
13/10/2018	1033	37	36	12º 04.969' S	24º 55.818'	50; 5
14/10/2018	0435	38	37	14º 46.784' S	24º 59.086'	50; 5
14/10/2018	1307	40	38	16º 01.942' S	25º 01.412'	50; 5
15/10/2018	0435	41	39	18º 20.357' S	25º 05.143'	50; 5
16/10/2018	0449	43	40	20º 22.761' S	25º 03.565'	50; 5
16/10/2018	1301	44	41	21º 36.224' S	25º 02.786'	50; 5

17/10/2018	0431	45	42	23º 59.974' S	24º 59.965'	50; 5
17/10/2018	1303	46	43	24º 54.350' S	25º 54.196'	50; 5
18/10/2018	0443	47	44	26º 37.678' S	27º 39.321'	50; 5
18/10/2018	1036	48	45	27º 12.003' S	28º 15.001'	50; 5
19/10/2018	0436	49	46	29º 07.655' S	30º 13.409'	50; 5
19/10/2018	1301	50	47	30º 00.355' S	31º 06.982'	50; 5
20/10/2018	0444	51	48	31º 37.104' S	32º 53.058'	50; 5
20/10/2018	1312	52	49	32º 22.371' S	33º 40.448'	50; 5
21/10/2018	0440	53	50	33º 49.894' S	35º 16.130'	50; 5
21/10/2018	1310	54	51	34º 34.830' S	36º 05.486'	50; 5
22/10/2018	0445	55	52	36º 10.029' S	37º 51.980'	50; 5
22/10/2018	1315	56	53	37º 00.723' S	38º 50.077'	50; 5
23/10/2018	0437	57	54	38º 35.043' S	40º 39.307'	50; 7
23/10/2018	1311	58	55	39º 12.560' S	41º 28.505'	50; 8
24/10/2018	0441	59	56	40º 31.255' S	43º 04.973'	50; 5
24/10/2018	1309	60	57	41º 22.179' S	44º 00.764'	50; 5
25/10/2018	0540	61	58	43º 00.361' S	45º 58.902'	50; 5
25/10/2018	1406	62	59	43º 47.429' S	46º 57.313'	50; 5
26/10/2018	0538	63	60	45º 17.852' S	48º 53.783'	50; 5
26/10/2018	1409	64	61	46º 01.052' S	49º 52.339'	50; 5
27/10/2018	0637	65	62	47º 33.709' S	51º 46.436'	66; 5
27/10/2018	1503	66	63	48º 11.932' S	52º 41.362'	40; 5

Table 2: Underway discrete samples collected for microbial proteomic analyses

DATE	TIME	AMT Station No.	Sample No.	Lat	LONG (W)
27/09/2018	0330	04	001	46º 01.745' N	12º 43.950
29/09/2018	0330	08	002	39º 43.158 ' N	17º 42.968'
01/10/2018	0430	12	003	33º 2.816' N	22º 08'.206'

03/10/2018	0430	16	004	26º 12.227' N	25º 31.264'
05/10/2018	0430	20	005	19º 04.664' N	28º 49.004'
07/10/2018	0430	24	006	11º 26.819'N	27º 42.524'
09/10/2018	0430	29	007	03º 48.465' N	25º 50.148'
11/10/2018	0430	32	008	03º 41.467' S	24º 58.694'
13/10/2018	0430	36	009	11º 15.739' S	24º 56.250'
15/10/2018	0430	41	010	18º 20.357' S	25º 05.143'
17/10/2018	0430	45	011	23º 59.974' S	24º 59.965'
19/10/2018	0430	49	012	29º 07.655' S	30º 13.409'
21/10/2018	0430	53	013	33º 49.894' S	35º 16.130'
23/10/2018	0430	57	014	38º 35.043' S	40º 39.307'
25/10/2018	0530	61	015	43º 00.361' S	45º 58.902'
27/10/2018	0630	65	016	47º 33.709' S	51º 46.436'

DNA Sample Collection

Arwen Bargery[1] for Andy Rees[2]
1: British Oceanographic Data Centre, 2: Plymouth Marine Laboratory

Cruise Objectives

Collection of CTD seawater samples for determination of DNA, collected for DNA archives.

Methods

Each pre-dawn and noon CTD cast was sampled for DNA analysis by collecting 5 litres of seawater into sampling carboys. Two depths were sampled from each CTD cast, with seawater samples collected from Niskin bottles fired at both the surface (5m) and the Deep Chlorophyll Maximum (DCM). In total, 122 samples were collected during the cruise, from 62 CTD casts.

Seawater samples were filtered through Sterivex-GP, 0.22 µm sterile vented filter units (SVGP01050) by using a ColePalmer-MasterFlex L/S Economy Drive Multichannel Pump (Model 7535-08). Where carboys were not full, the volume filtered was measured. After filtration, the Sterivex filters were preserved by adding 1mL of RNAlater Solution (Invitrogen by Thermo fisher scientific). Afterwards, all Sterivex units were sealed with Cole-Parmer Male Luer integral lock ring plugs and Chase Instruments Cha-seal, then stored at -80°C in a freezer until return to Plymouth Marine Laboratory for analysis.

Table 1: Table showing CTD samples collected during the cruise for DNA analysis.

Date and Time	Station Number	CTD Cast	Lat (+ve N)	Lon (+ve E)	Niskin Bottles Sampled	Depths Sampled (m)
26/09/2018 03:34	2	CTD002	48.469	-8.837	9, 22	60, 5
26/09/2018 12:10	3	CTD003	47.901	-10.381	14, 22	30, 5
27/09/2018 03:30	4	CTD004	46.029	-12.733	9, 22	60, 5
27/09/2018 12:07	5	CTD005	44.979	-13.589	12, 22	40, 5
28/09/2018 03:33	6	CTD006	42.967	-15.213	10, 22	52, 5
28/09/2018 12:01	7	CTD007	41.912	-16.036	10, 22	56, 5
29/09/2018 03:34	8	CTD008	39.719	-17.716	9, 22	71, 5
29/09/2018 12:00	9	CTD009	38.631	-18.526	9, 22	70, 5
30/09/2018 04:34	10	CTD010	36.414	-20.122	9, 23	105, 5
30/09/2018 12.59	11	CTD011	35.302	-20.915	8, 22	105, 5
01/10/2018 04:38	12	CTD012	33.047	-22.137	6, 22	90, 5
01/10/2018 13:07	13	CTD013	31.924	-22.710	9, 22	85, 5
02/10/2018 04:37	14	CTD014	29.488	-23.933	10, 23	114, 5
02/10/2018 10:50	15	CTD015	28.609	-24.361	10, 23	135, 5
03/10/2018 04:37	16	CTD016	26.204	-25.521	9, 23	107, 5
03/10/2018 13:01	17	CTD017	25.058	-26.057	8, 22	120, 5
04/10/2018 04:27	18	CTD018	22.600	-27.213	11, 23	93, 5
04/10/2018 13:01	19	CTD019	21.447	-27.745	8, 22	120, 5
05/10/2018 04:38	20	CTD020	19.078	-28.817	9, 23	90, 5
05/10/2018 13:01	21	CTD021	17.747	-28.930	10, 22	65, 5
06/10/2018 04:38	22	CTD022	15.076	-28.613	13, 22	57, 5
06/10/2018 13:01	23	CTD023	13.812	-28.295	11, 22	60, 5
07/10/2018 04:37	24	CTD024	11.447	-27.709	10, 23	50, 5
07/10/2018 13:00	25	CTD025	10.098	-27.294	8, 14	40, 5
08/10/2018 04:38	27	CTD026	7.471	-26.650	10, 23	72, 5
08/10/2018 13:02	28	CTD027	6.256	-26.380	11, 22	64, 5
09/10/2018 04:39	29	CTD028	3.808	-25.836	10, 23	89, 5
10/10/2018 04:46	30	CTD029	0.001	-24.999	10, 23	60, 5
10/10/2018 13:04	31	CTD030	-1.152	-24.991	10, 20	75, 5
11/10/2018 04:30	32	CTD031	-3.691	-24.978	11, 23	60, 5
11/10/2018 13:02	33	CTD032	-4.985	-24.973	10, 20	74, 5
12/10/2018 04:39	34	CTD033	-7.549	-24.957	10, 23	110, 5
12/10/2018 13:01	35	CTD034	-8.763	-24.949	8, 21	120, 5
13/10/2018 04:35	36	CTD035	-11.262	-24.938	9, 23	122, 5
13/10/2018 10:33	37	CTD036	-12.083	-24.930	13, 23	111, 5

14/10/2018 04:35	38	CTD037	-14.780	-24.985	9, 23	145, 5
14/10/2018 13:07	40	CTD038	-16.032	-25.024	9, 21	160, 5
15/10/2018 04:35	41	CTD039	-18.339	-25.086	7, 22	152, 5
16/10/2018 04:39	43	CTD040	-20.379	-25.060	8, 23	161, 5
16/10/2018 13:01	44	CTD041	-21.604	-25.047	9, 21	170, 5
17/10/2018 04:31	45	CTD042	-24.000	-24.999	10, 23	140, 5
17/10/2018 13:03	46	CTD043	-24.906	-25.903	10, 21	140, 5
18/10/2018 04:43	47	CTD044	-26.628	-27.655	8, 23	127, 5
18/10/2018 10:36	48	CTD045	-27.200	-28.250	15, 23	140, 5
19/10/2018 04:36	49	CTD046	-29.128	-30.224	9, 23	130, 5
19/10/2018 13:01	50	CTD047	-30.006	-31.150	14, 24	109, 5
20/10/2018 04:45	51	CTD048	-31.619	-32.884	8, 23	131, 5
20/10/2018 13:12	52	CTD049	-32.373	-33.674	16, 24	85, 5
21/10/2018 04:40	53	CTD050	-33.832	-35.269	11, 23	80, 5
21/10/2018 13:10	54	CTD051	-34.581	-36.092	17, 23	70, 5
22/10/2018 04:45	55	CTD052	-36.167	-37.866	9, 23	70, 5
22/10/2018 13:15	56	CTD053	-37.012	-38.835	14, 22	40, 5
23/10/2018 04:37	57	CTD054	-38.584	-40.655	7, 17	65, 7
23/10/2018 13:11	58	CTD055	-39.209	-41.475	19, 23	30, 8
24/10/2018 04:41	59	CTD056	-40.521	-43.083	9, 23	40, 5
24/10/2018 13:09	60	CTD057	-41.370	-44.013	19, 23	35, 5
25/10/2018 05:40	61	CTD058	-43.006	-45.982	12, 23	55, 5
25/10/2018 14:06	62	CTD059	-43.791	-46.955	21	5
26/10/2018 05:38	63	CTD060	-45.298	-48.896	23	5
26/10/2018 14:09	64	CTD061	-46.018	-49.872	15, 21	30, 5
27/10/2018 06:57	65	CTD062	-47.562	-51.774	10, 18	66, 5
27/10/2018 15:03	66	CTD063	-48.199	-52.689	14,20	40, 5

SOCCOM and ARGO floats

John Ballard
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Objectives

Deploy Southern Ocean Carbon and Climate Observations and Modelling Programme (SOCCOM. https://soccom.princeton.edu/) floats and University of Washington ARGO floats at specific desired coordinates along the AMT28 cruise track. Collect and analyze parameters important for SOCCOM sensor calibration, validation, and reference database. These parameters include fluorescence, backscatter, POC, pH/TA, salinity, dissolved inorganic nutrients, and oxygen. The six SOCCOM floats deployed on the cruise were adopted by schools in the USA and were graffitied before being deployed (Figure 1).

Figure 1: SOCCOM floats adopted by schools in the USA and graffitied on board prior to deployment

Deployments

Table 1: 3 Argo and 6 SOCCOM float deployment details for AMT28 (For a table of all float deployments, refer to next report):

UTC time	UTC date	Station	CTD	Lat (N)	Lon (E)	Float ID	Float type
08:57	14/10/18	39	n/a	-15.40784	-25.00084	12691	SOS (CF)
05:35	16/10/18	43	40	-20.37916	-25.05984	12632	ARGO (AI)
12:59	17/10/18	46	43	-24.9059	-25.90328	12776	SOS (CF)
12:21	18/10/18	48	45	-27.20013	-28.25005	12696	BGC (CF)
12:26	18/10/18	48	45	-27.20081	-28.2498	12883	BGC (CF)
15:08	20/10/18	52	49	-32.37702	-33.67523	12881	BGC (CF)
14:51	21/10/18	54	51	-34.58331	-36.09178	12700	BGC (CF)
14:56	23/10/18	58	55	-39.20996	-41.47501	12747	BGC (CF)
14:52	24/10/18	60	57	-41.37037	-44.01361	12778	BGC (CF)

All 3 Argo floats and SOCCOM floats 12696 and 12883 were lowered by hand line on the aft starboard corner of the ship. Due to increased sea state and geometry of the ship's hull, SOCCOM floats 12881, 12700, 12747, and 12778 were deployed with the starboard crane and quick release pin.

Table 2: SOCCOM float IDs and their adopted schools

Float ID	School
12696	Mount San Antonio College, California
12883	North Bay elementary School, Oregon
12881	Forest Park High School, Virginia
12700	Marjory Stoneman Douglas High School, Parkland, Florida
12747	Curtis Inge Middle School, Oklahoma
12778	Brooksville Elementary School, Florida

POC/HPLC

For the CTD casts immediately before SOCCOM deployments, Niskin bottles at the chlorophyll maximum and surface were sampled for POC/HPLC filtration. 1-2 L per samples were filtered under vacuum and flash-frozen in liquid nitrogen. The filters were preserved in the -80^{o}C freezer for future analysis on land.

Table 3: Niskin bottles sampled for POC/HPLC analysis

UTC time	UTC date	Station	CTD	Lat (N)	Lon (E)	POC/HPLC niskins
12:21	18/10/18	48	45	-27.20013	-28.25005	16, 22
15:08	20/10/18	52	49	-32.37702	-33.67523	17, 24
14:51	21/10/18	54	51	-34.58331	-36.09178	17, 22
14:56	23/10/18	58	55	-39.20996	-41.47501	20, 22
14:52	24/10/18	60	57	-41.37037	-44.01361	20, 22

pH/Total Alkalinity

For the CTD casts immediately before SOCCOM deployments, 500 mL from each depth was pickled with mercuric chloride and sealed with a greased ground glass stopper. Two duplicates from the same Niskin bottle were taken for each cast at random depths. Samples will be analyzed by Andrew Dickson's lab at a future date.

Table 4: Niskin bottles sampled for pH/total alkalinity

UTC time	UTC date	Station	CTD	Lat (N +ve)	Lon (E +ve)	pH/TA Niskins
12:21	18/10/18	48	45	-27.20013	-28.25005	1-15,17,18,19,20,21,22
15:08	20/10/18	52	49	-32.37702	-33.67523	1-21,23
14:51	21/10/18	54	51	-34.58331	-36.09178	1-17,19,2122
14:56	23/10/18	58	55	-39.20996	-41.47501	1-19,21,22
14:52	24/10/18	60	57	-41.37037	-44.01361	1-19,21,22

FLBB

A Wet Labs FLBB-RTD sensor was mounted on the CTD at the beginning of the AMT28 cruise for the purpose of comparison to the FLBB sensors on each SOCCOM float deployed. A custom cable was fabricated on board to mate to the CTD. The cable failed with a ground short on Station 44 (CTD 41). The cable was repaired and mounted back on the rosette for Station 46 (CTD 43). A dark cast, where the detectors are taped over for the cast, was performed at stations 7, 46, and 65 (CTD 7, 46, and 62).

Summary of all Float Deployments on AMT 28

Table 1: Summary of all floats deployed on AMT28

					DEPLOYMENT DETAILS			
Organisation	**Organisation deployment number**	**AMT28 deployment number**	**Float type**	**Serial no./ Apfid**	**Date in 2018**	**Time (GMT)**	**Lat S**	**Lon W**
Univ. Washington	1	Argo 01	SOS (CF)	12691	Sun 14 Oct	08:57	15.40768	25.00007
UK Met Office	1	Argo 02	ARGO	7001	Sun 14 Oct	08:59	15.40784	25.00084
Univ. Washington	2	Argo 03	ARGO (AL)	12632	Tue 16 Oct	05:35	20.37916	25.05984
Univ. Washington	3	Argo 04	SOS (CF)	12776	Wed 17 Oct	14:02	24.90627	25.90277
UK Met Office	2	Argo 05	ARGO	7589	Thu 18 Oct	05:39	26.62794	27.65496
SOCCOM	1	Argo 06	BGC (CF)	12696	Thu 18 Oct	12:22	27.20025	28.24999
SOCCOM	2	Argo 07	BGC (CF)	12883	Thu 18 Oct	12:28	27.20098	28.24975
SOCCOM	3	Argo 08	BGC (CF)	12881	Sat 20 Oct	15:09	32.37702	33.67523
UK Met Office	3	Argo 09	ARGO	8064	Sun 21 Oct	14:44	34.58132	36.09154
SOCCOM	4	Argo 10	BGC (CF)	12700	Sun 21 Oct	14:51	34.58331	36.09178
UK Met Office	4	Argo 11	ARGO	8065	Mon 22 Oct	14:25	37.01203	38.83492
SOCCOM	5	Argo 12	BGC (CF)	12747	Tue 23 Oct	14:56	39.20996	41.47501
SOCCOM	6	Argo 13	BGC (AL)	12778	Wed 24 Oct	14:52	41.36965	44.01273

Ship's systems Reports

CTD and underway sensor calibrations

Arwen Bargery
British Oceanographic Data Centre

Cruise Objectives

In total, 63 CTD casts along the cruise transect were deployed to obtain profiles of the water column from a range of sensors. All casts were conventional profiling casts with 24 x 20 L Ocean Test Equipment (OTE) Niskin bottles for sampling water. CTDs were deployed pre-dawn at ~04:30 and noon ~13:00 ship time each day, from 25th September 2018 until 27th October 2018. Profiles were generally down to 500 metres depth twice a day, with 2 CTDs above 150 m on the European continental shelf, five CTDs to 1500 m, a CTD to 4000 m and a CTD to 4200 m. Sensors on the CTD included pressure, temperature, conductivity, oxygen, fluorescence, PAR, turbidity, transmittance and attenuance.

Methods

The Sea-Bird data collection software Seasave-Win32 recorded the raw data output from the CTD casts. Processing the raw data occurred daily, following the BODC recommended guidelines using SBE Data Processing-Win32 v7.26.7. Outlined below are the processing routines used to convert the raw CTD data into CNV files, each routine is named after each stage in brackets < >.

Conversion of the raw binary Sea-Bird files to ASCII files (CNV) containing the 24 Hz data for up and down casts <DatCnv>. Generation of bottle files for each cast containing the mean values of all the variables at the time of bottle firing events <Bottle Summary>. Using the CNV files, processing routines were applied to remove pressure spikes <WildEdit>. Following this the oxygen sensor was then shifted relative to the pressure by 2 seconds, to compensate for the lag in the sensor response time <AlignCTD> and the effect of thermal 'inertia' on the conductivity cells was removed <CellTM>. The surface soak for each cast was identified using <SeaPlot> and removed manually using a text editor. LoopEdit was run to mark scans with a bad flag wherever there was a pressure slowdown or reversal. Salinity and oxygen concentration were re-derived and density (sigma-theta) values were derived <Derive> after the corrections for sensor lag and thermal 'inertia' had been applied. The CTD files produced from Sea-Bird processing were converted from 24 Hz ascii files into 1 dbar downcast files for calibration and visualisation on-board <BinAverage>. Removal of the initial salinity and oxygen channels produced at the DatCnv stage, along with the conductivity, voltage and altimeter channels from the 1-dbar downcast files <Strip>.

Collation of the sensor values at bottle firing generated by the Bottle Summary routine formed the dataset for calibrating the two CTD salinity sensors and oxygen sensor against discrete bench salinometer measurements and oxygen Winkler measurements, respectively. The fluorometer sensor will be calibrated post-cruise using AC-9 data calibrated against HPLC data.

To generate a calibration, an offset between the discrete water sample measurement (salinity/oxygen) and the nominal value from the sensor at bottle firing was calculated. Outliers were identified using plots of offset against the discrete sample values and a linear regression was applied.

Where the regression was strong and significant the calibration equation was derived by rearranging the regression equation:

Offset = a * Discrete sample + b

Where offset = Discrete sample – Sensor value

To give Calibrated value = 1/(1-a) * Sensor value + b/(1-a)

Where the regression was not significant or did not improve the dataset, the mean value of the offset was applied.

All provisional calibration datasets will be checked and confirmed once back at BODC. Calibration datasets are available upon request from BODC post cruise.

Provisional Results

- Temperature

There were no independent measurements of temperature made during the cruise and the two CTD temperature sensors on the rig returned consistent data. There was no further calibration of these sensors. Figure 1 below shows the section plot of the primary temperature sensor along the cruise track.

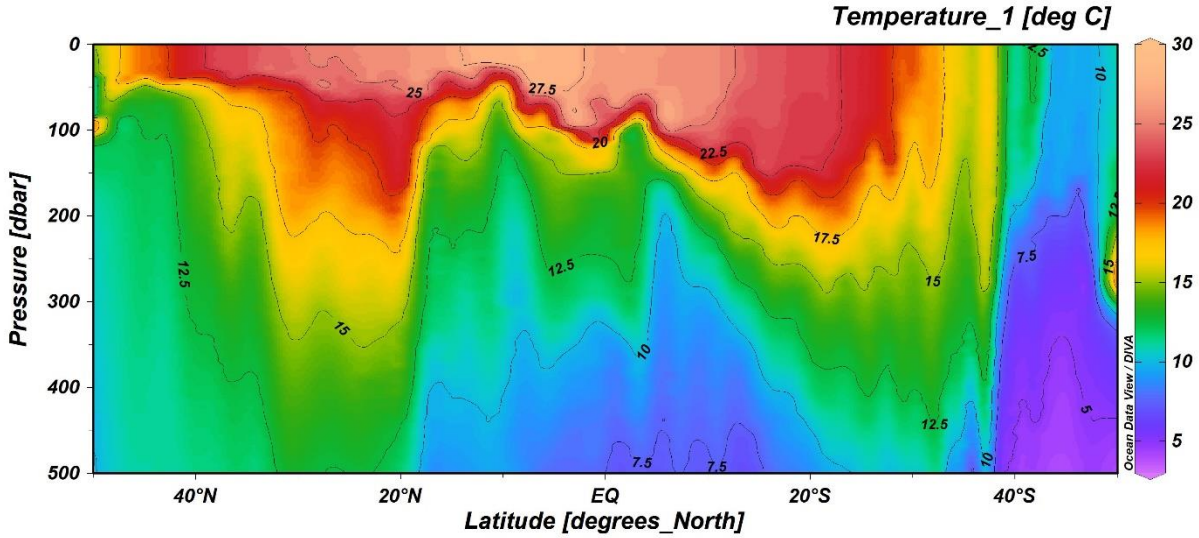


Figure 1: Temperature section plot along the AMT28 transect by latitude (50 deg N – 50 deg S) from the primary temperature sensor, located on the CTD vane.

- Salinity

The salinity channels were calibrated against bench salinometer measurements from five samples collected from each CTD cast. Further details of these measurements can be found in the salinity sampling cruise report section.

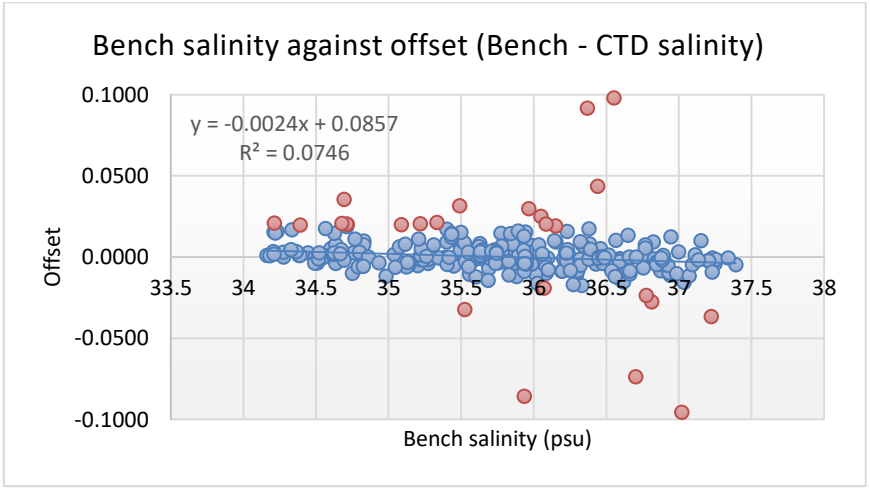


Figure 2: Salinity offsets for the primary salinity sensor against discrete sample salinity measured with a bench salinometer.

For salinity sensor 1, there was a weak but significant relationship between bench salinity and offset (n = 281; r^2 = 0.0746; p < 0.001). However, applying a regression did not improve the dataset so the mean offset was applied.

Calibrated primary salinity = uncalibrated salinity + 0.0000177

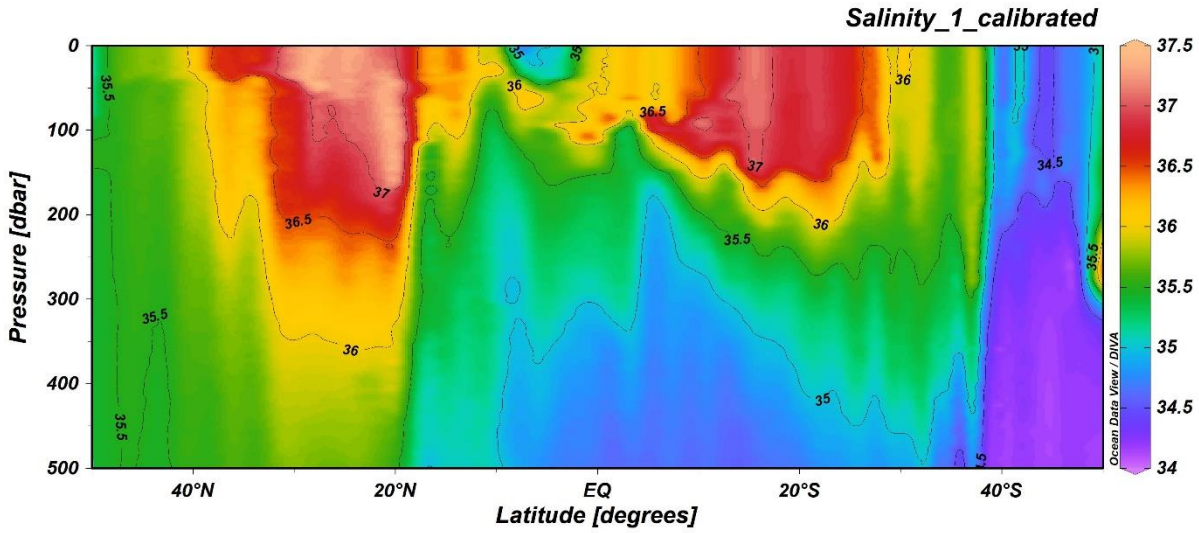


Figure 3: Salinity section plot along the AMT28 transect by latitude (50 deg N – 50 deg S) from the primary salinity sensor.

The secondary CTD salinity sensor was calibrated against discrete salinity measurements. Again, there was a weak but significant relationship between bench salinity and offset (n = 284; r^2 = 0.0938; p < 0.001). Applying a regression did not improve the dataset so the mean offset was applied.

Calibrated secondary salinity = uncalibrated salinity - 0.000156

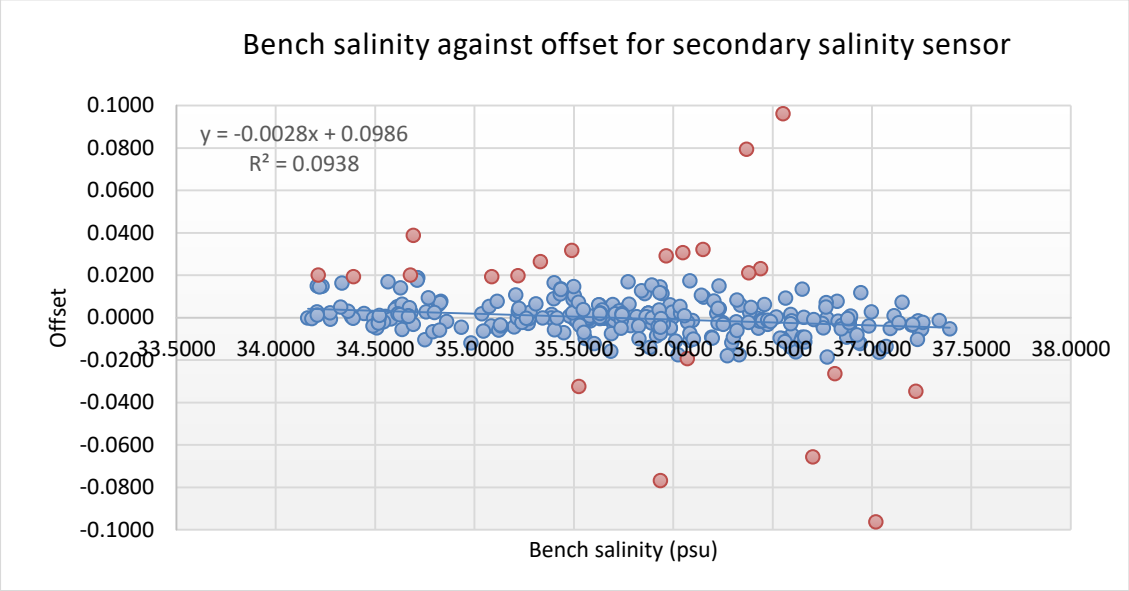


Figure 4: Salinity offsets for the secondary salinity sensor against discrete sample salinity measured with a bench salinometer.

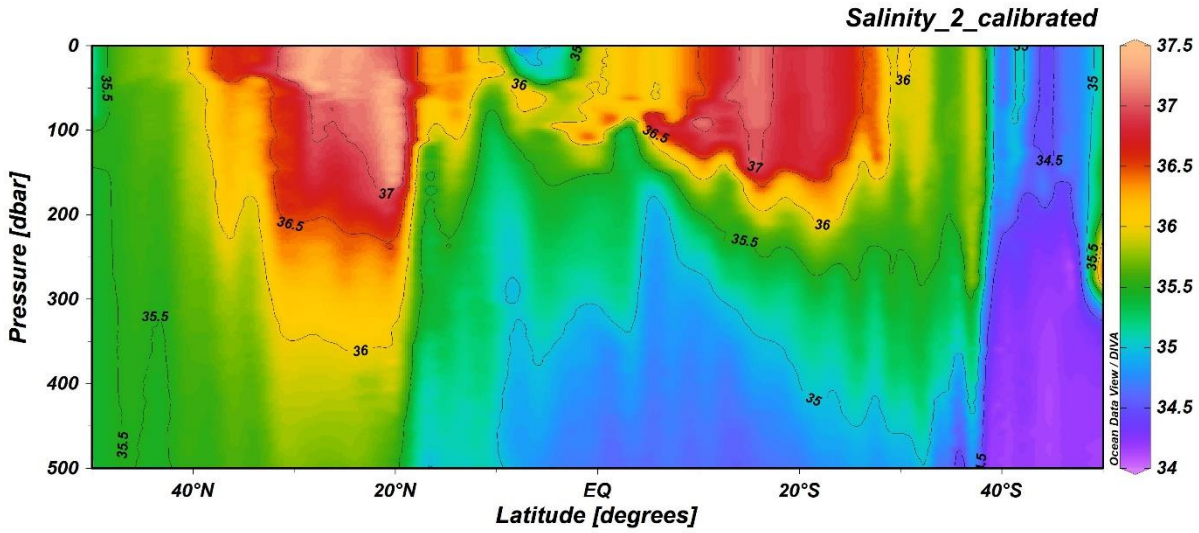


Figure 5: Salinity section plot along the AMT28 transect by latitude (50 deg N – 50 deg S) from the secondary salinity sensor calibrated against bench salinity samples.

- Oxygen

Calibration of the SBE 43 oxygen sensor against discrete oxygen Winkler titration measurements used five depths collected from the pre-dawn and noon CTDs. More details are available in Carol Robinsons' cruise report. The oxygen sensor operated without problem throughout the remainder of the cruise. Several data points did not fit the pattern observed with the data from the other casts and so were excluded from the calibration data set. There was a strong, significant relationship between the offset and the discrete oxygen data, so that the trend below was applied to the CTD oxygen data.

The calibration equation:

Calibrated $O_{2\ (\text{in } \mu\text{mol/l})}$ = 1.01804 * sensor $O_{2\ (\text{in } \mu\text{mol/l})}$ + 0.590175 (n = 199; r^2 = 0.2249; p < 0.001);

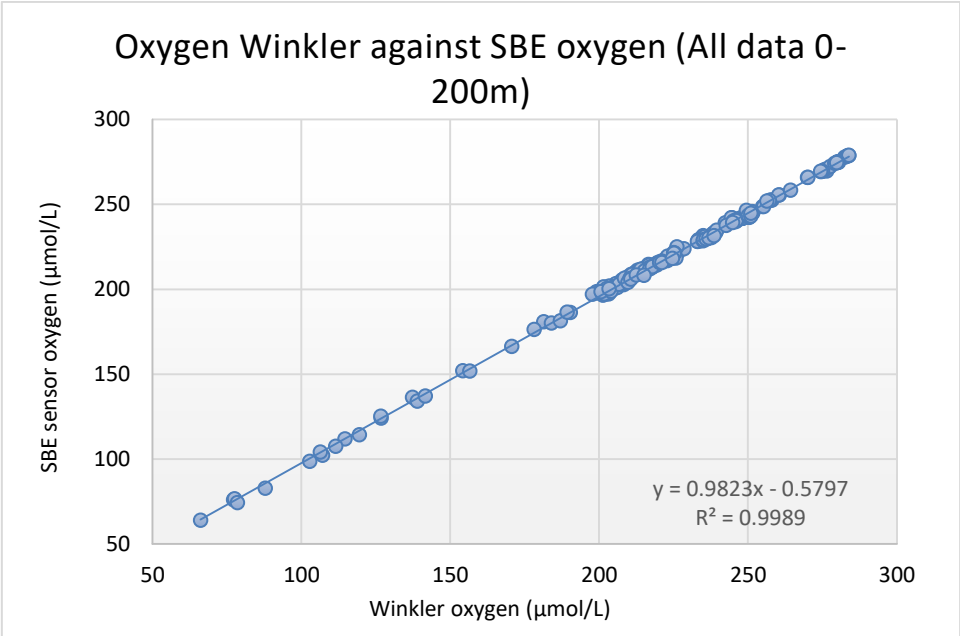


Figure 6: Oxygen concentration offsets against SBE CTD oxygen sensor measurements.

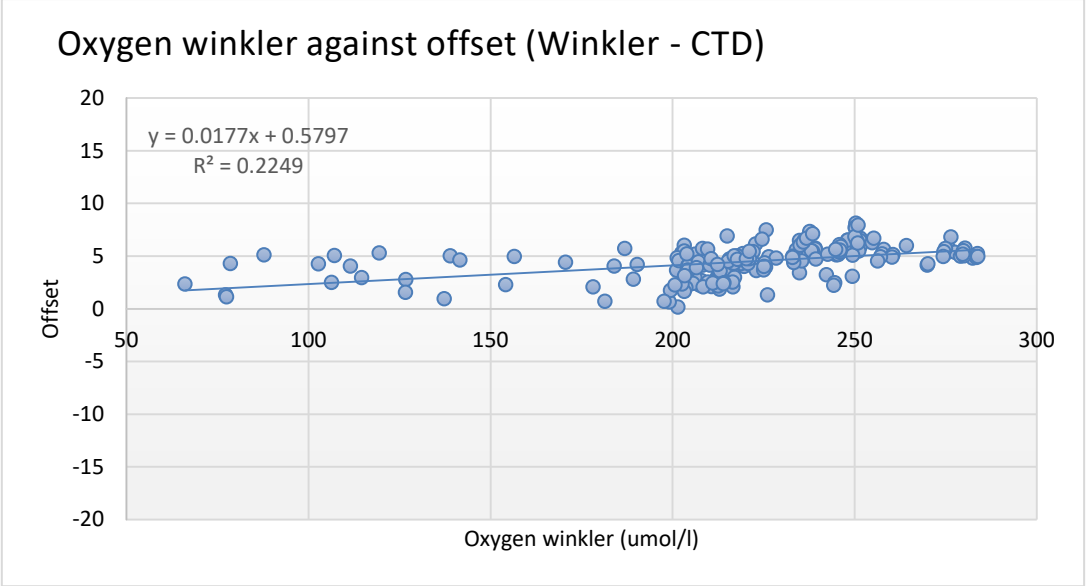


Figure 7: Oxygen concentration offsets against Winkler titration measurements from discrete samples.

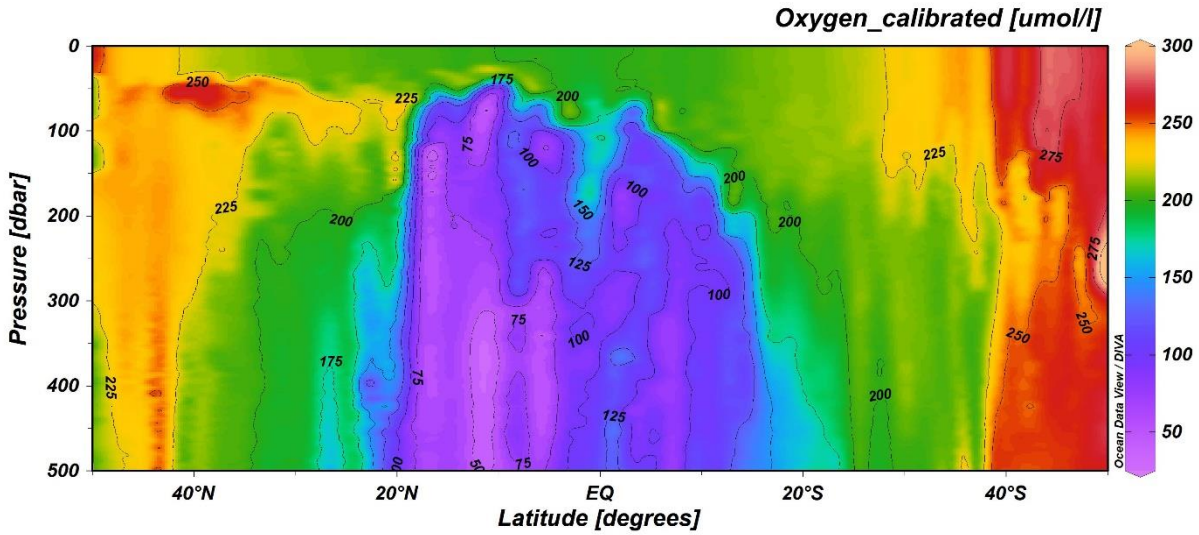


Figure 8: Oxygen concentration section plot along the AMT28 transect by latitude (50 deg N – 50 deg S) from the SBE43 oxygen sensor calibrated against Winkler titration samples.

- Fluorometer

The CTD fluorometer operated without problem during the cruise. Calibration of the CTD fluorometer sensor against sample data will be carried out after the cruise against AC-9 and HPLC data. A section plot of the fluorescence data along the AMT28 cruise track is shown below.

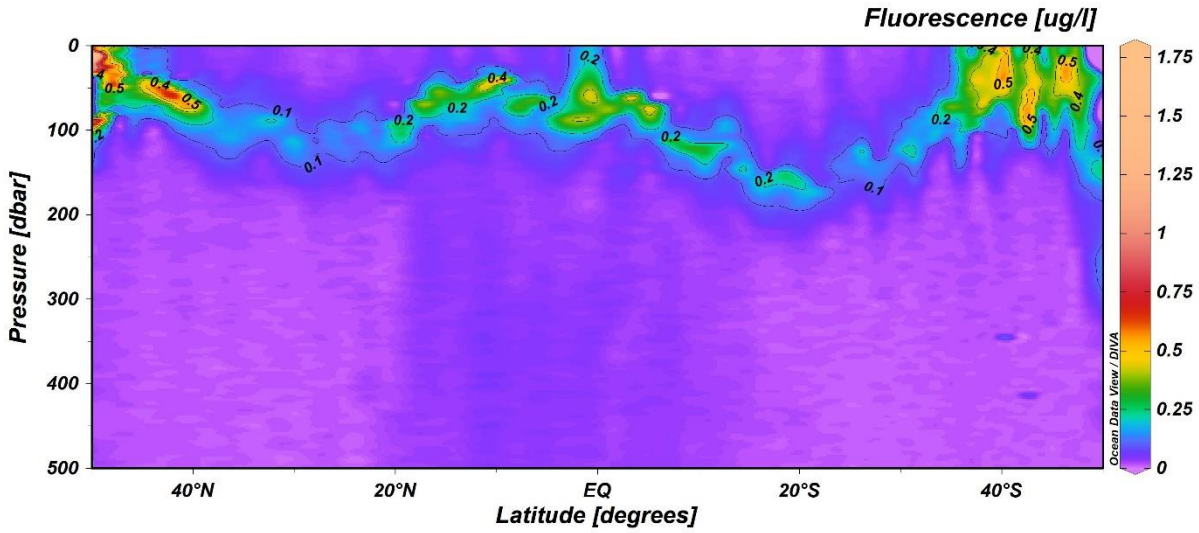


Figure 9: Fluorometer section plot along the AMT28 transect by latitude (50 deg N – 50 deg S).

Underway sensors

The ship's underway meteorological and surface systems were run continuously throughout the cruise. The sea surface hydrography system started logging from 23/09/2018 11:33 (UT) and was switched off prior to arrival at the Falklands on 28/10/2018. Samples were collected to calibrate the TSG connected to the ship's non-toxic flow-through system, which draws water from approximately 5.5 m below the water line on the RRS James Clark Ross.

Sea Surface Temperature Hull sensor (oceanlogger-sstemp)

The primary hull temperature sensor was calibrated against the mean of the primary and secondary CTD temperature sensor values from each CTD at 5.5 dbar. The isosurface temperature values at 5.5 dbar were calculated in Ocean Data View, by using the available temperature values to obtain a linearly interpolated value on the isosurface. Several values were excluded from the regression where the surface value was anomalous.

A regression analysis was performed on the offset (CTD temperature – underway temperature) against cruise day and offset against CTD temperature. Two trends were identified in the data: there was a strong and significant regression of the offset with surface CTD sensor values ($n = 51$; $r^2 = 0.2194$; $p < 0.05$) and a weak but significant relationship of offset with cruise day ($n=51$; $r^2 = 0.153$; $p <0.05$). The stronger relationship was adjusted for by applying the regression equation for the trend with CTD temperature.

Calibrated underway temperature = 1.001 * uncalibrated temp – 0.0369

The correction will be applied during BODC processing after the cruise before the data is made available online.

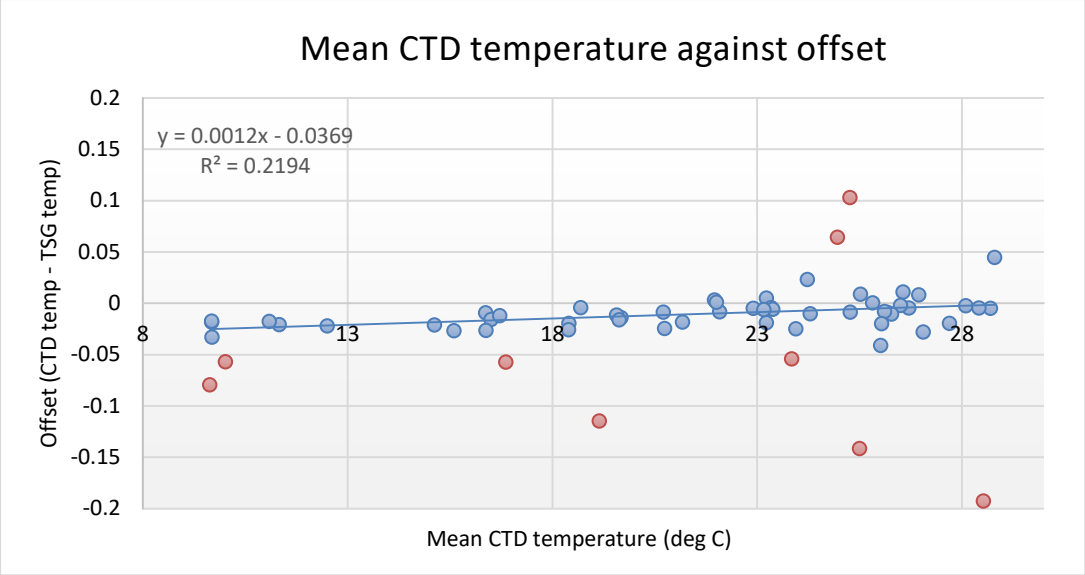


Figure 10: Hull sensor temperature offsets against surface CTD temperature measurements.

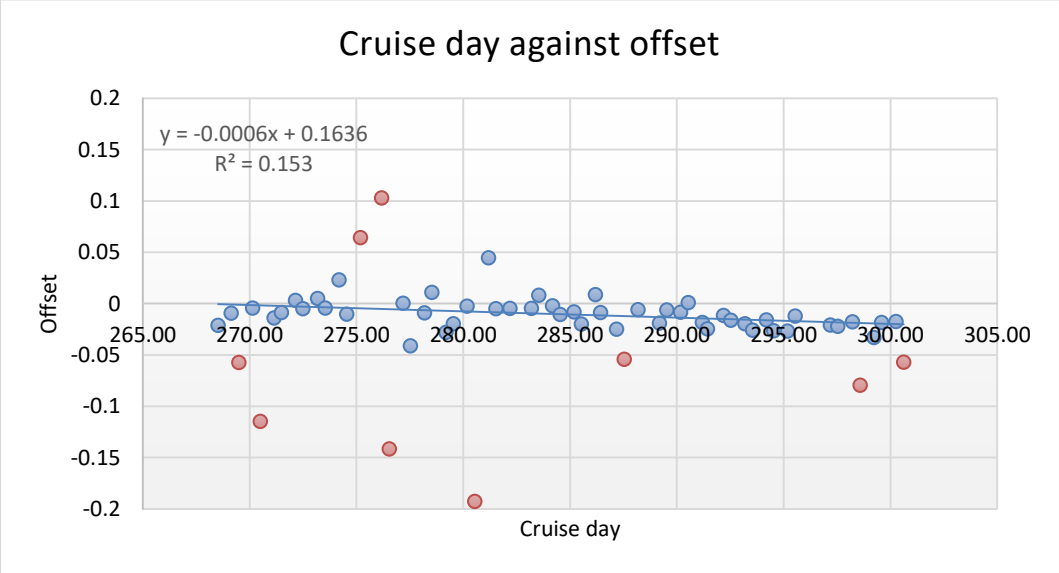


Figure 11: Hull sensor temperature offsets against cruise day.

Salinity

The TSG sensor salinity data were calibrated against samples collected and analysed with a bench salinometer. Up to four samples were collected each day at approximately 08:00, 12:00, 16:00 and 20:00, ship's time. The offset between bench salinity and underway TSG salinity sensor value was calculated. Several outliers were identified when plotting offset against bench salinity and cruise day, which were excluded from the calibration dataset. There was not a significant regression of the offset with bench salinity measurement ($n = 116$; $r^2 = 0.0018$; $p > 0.05$) and the regression between cruise day and offset was also not significant ($n = 116$; $r^2 = 0.01425$; $p > 0.05$) so the mean offset was applied to the TSG data.

Calibrated salinity = TSG salinity + 0.0076

The correction will be applied during BODC processing after the cruise before the data is made available online.

Fluorometer

The underway fluorometer data will be calibrated against AC-9 and HPLC data generated during the cruise back at PML. The correction will be applied during BODC processing after the cruise before the data are made available online.

AME Scientific Ship Systems Report

Sean Quirk, Ship Science Engineer. seairk@bas.ac.uk

British Antarctic Survey, Cambridge, UK

Contents

1 Cruise Summary

Cruise	Departure	Arrival	AME Engineer(s)
JR18001	23/09/18 Harwich UK	03/11/18 Stanley FI	Sean Quirk (seairk@bas.ac.uk)

This cruise is part of the AMT science programme, with 2 stations per day; one pre dawn 04:30 and the other at normally at 13:00. The stations include CTD, Plankton nets, Optics Rig, SOD deployment, weather balloon and float deployment.

2 Instrumentation

2.1 Systems used on cruise

Instrument	#SN if Used	Make and Model	Comments
Lab Instruments			
AutoSal	68533/65753	OSIL 8400B	
Scintillation counter	SGTC20150612	PERKINELMER TRI-CARB 2910TR	
XBT	No		
Acoustic			
ADCP	Yes		
EM122	Yes		
TOPAS	Yes		
EK60/80	Yes		
K-Sync	Yes		
SSU	No		

USBL	Yes	Sonardyne Ranger 1	
10kHz IOS Pinger	No		
Benthos 12kHz Pinger	No		
Benthos 14kHz Pinger	No		
Mors 10kHz Transponder	No		
EA600	Yes		Bridge Equipment but logged
Oceanlogger			
Barometer1	V145002	VAISALA PTB210B1A2B	Inside the UIC
Barometer2	V145003	VAISALA PTB210B1A2B	Inside the UIC
Air humidity & temp1	61019333	Rotronic Hygroclip 2	On Foremast Port not checked changed at end of JR17007
Air humidity & temp2	61019251	Rotronic Hygroclip 2	On Foremast Stbd not checked changed at end of JR17007
TIR1 sensor (pyranometer)	172882	Kipp & Zonen Sp Lite2	On Foremast S/N not checked assumed from JR17007
TIR2 sensor (pyranometer)	172883	Kipp & Zonen Sp Lite2	On Foremast S/N not checked assumed from JR17007
PAR1 sensor	160959	Kipp & Zonen PQS-1	On Foremast S/N not checked assumed from JR17007
PAR2 sensor	160960	Kipp & Zonen PQS-1	On Foremast S/N not checked assumed from JR17007
Thermosalinograph	0072 and 0018	SBE45	PrepLab SN 0072 has a faulty conductivity sensor
Transmissometer	1497DR	CST-846DR	PrepLab
Fluorometer	1498	WSCHL-1498	PrepLab
Flow meter	05/811950	LitreMeter F112-P-HC-AP-OR-PP	PrepLab
Seawater temp 1	0765	SBE38	Sea Inlet
Seawater temp 2	0771	SBE38	Sea Inlet
CTD			
Deck unit 1	0458	SBE11plus	
Underwater ACD/ Depth	1225	SBE9plus	
Temp1	5645	SBE3plus	
Temp2	2191	SBE3plus	
Cond1	3248	SBE 4C	
Cond2	4126	SBE 4C	
Pump1	1807	SBE5T	
Pump2	7966	SBE5T	

Standards Thermometer	0061	SBE35 0024	
Transmissometer	527DR	C-Star	
Oxygen sensor	0620	SBE43	
PAR sensor	70442	QCP2350	
Fluorometer	12.8513-001	CTG Aqua Tracker MkIII	
Altimeter	10127.244739	Tritech	
CTD swivel linkage	1961018	Focal Technologies Group	
LADCP Master Down	14443	TeleDyne WHM300	
LADCP Slave Up	No	TeleDyne WHM300	
Pylon	0636	SBE32	
Other ship's systems (non-AME)			
Anemometer	Yes		Bridge Equipment, logged
Ships Gyro	Yes		Bridge Equipment, logged
System(s) brought by science team (non-AME)			
Fluorometer + Backscatter	4795	Seabird Eco FLBBRTD	University of Washington provided by J.Ballard

2.2 Notes for Heading and Course Instruments

2.2.1 Seatex

The Seatex was calibrated before the beginning of the cruise by Oceanfix Limited (RPS Energy) whilst alongside at Harwich. The antenna position has moved and the heading changed since the last offset survey was completed by Parker in 2014. The antenna position has been updated in the software. The gyros have also been calibrated and new C-O values need to be applied to the system. This was not done at the time due to imminent departure and substantial mobilisation work was still to be completed.

2.2.2 Ships Gyro

The vessel gyros were changed during the recent refit and again recalibrated as per the above. Again, the values have not been added to the system at this time.

2.3 Notes for Lab Instruments used

2.3.1 AutoSal

2.3.1.1 Autosal S/N 65833

Upon installation of Autosal SN 68533 it was noted that the internal tubing on the end of the cell was disconnected see below images in Figure 6 and Figure 7.

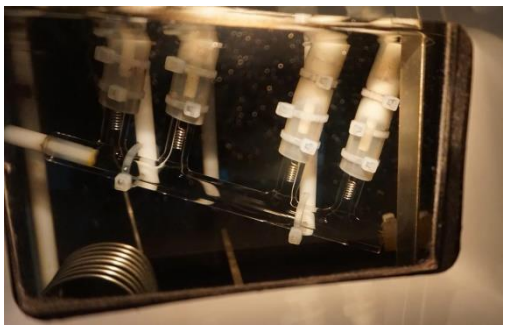


Figure 6:- Autosal S/N 65833 Cell Tubing Fault

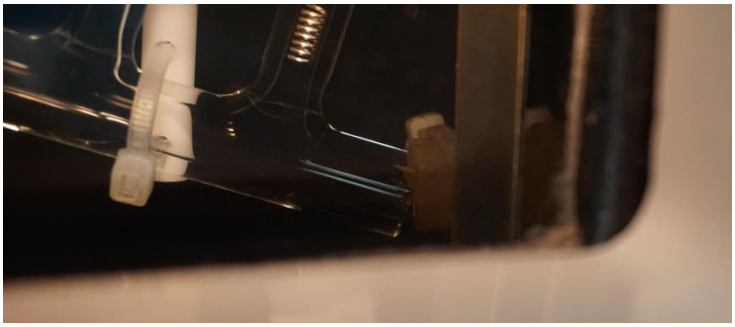


Figure 7- Autosal S/N 65833 Cell Tubing Fault

During this repair it was noted that the seawater inlet hosing into the conductivity cell was badly kinked this was also repaired.

Once the Autosal was initially repaired it only appeared to be working with the pumps on continuously. If the pumps were switched off then the conductivity reading dropped substantially. It was also noted that when with the cell was full of sample an air pocket would develop within the cell when the pumps were switched off. This was investigated and it was discovered that the air flushing manifold had a leak due to a missing cable tie when compared to the spare unit. This was replaced but there were further issues with air pockets developing. This was tracked down to a loose air line into the silicone bung at the air flushing manifold. This was repaired, with some extra silicone placed around the air line see below image in Figure 8.

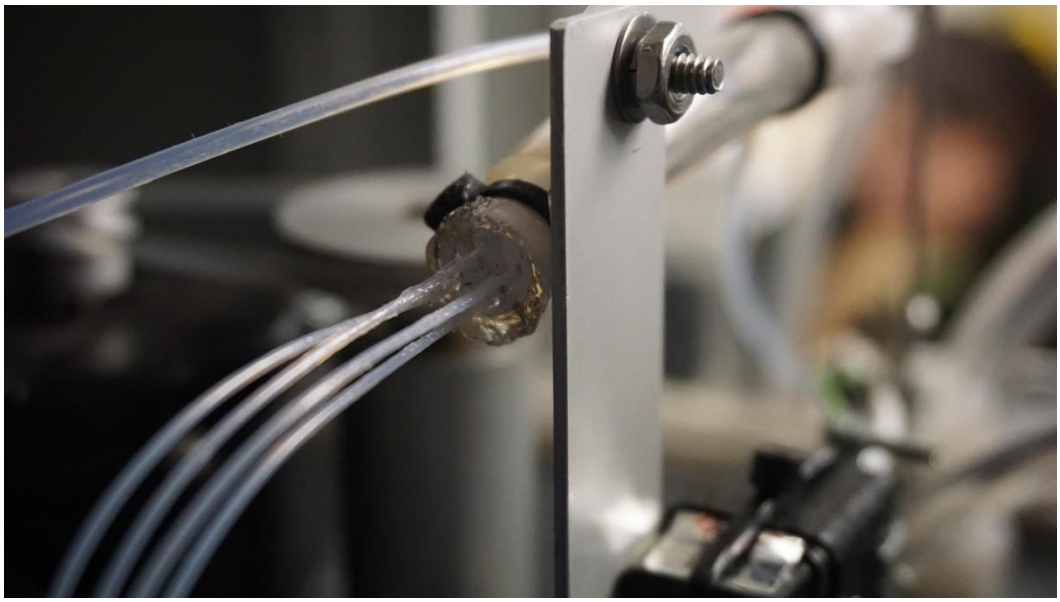


Figure 8:- Autosal S/N 65833 Air Flushing Manifold Repair

During the investigation into the air pocket the heating lamp was disconnected and the crimp terminals pulled off with no force being applied this was also repaired see below image in Figure 9.

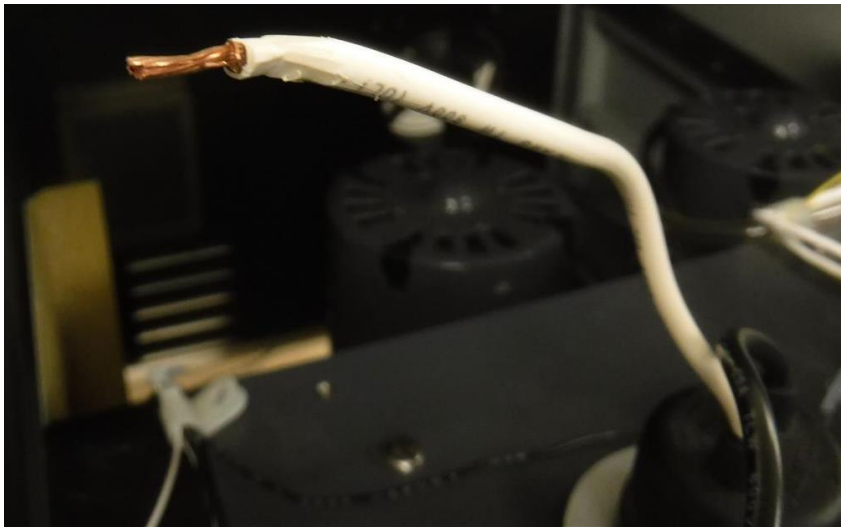


Figure 9:- Autosal S/N 65833 Broken heating lamp wire

Once these further repairs were carried out the Autosal would not give a consistent reading. It was discovered that the connection of the cell wires onto the connector was held on by 2 strands this came loose with a simple movement as shown in Figure 10.

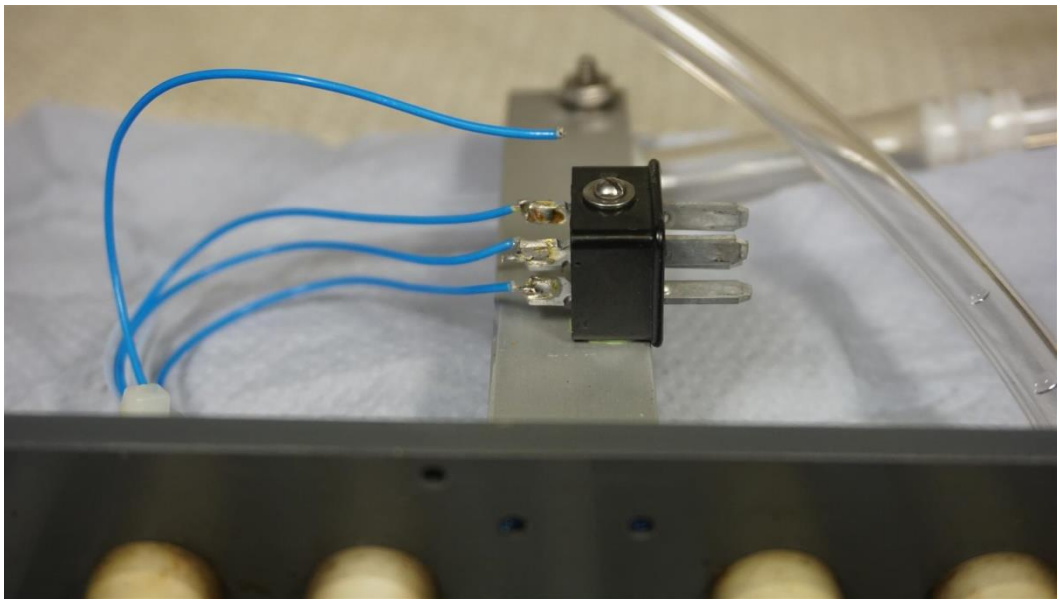


Figure 10:- Autosal S/N 68533 Broken cell wire

Once these repairs were complete cleaning of the cell was performed by making a mixture of methanol, Decon90 and Milli-Q water. This was left for 24 hours in the cell under recommendation from Becky Childs at OSIL.

The unit is currently still not functioning correctly with a continuous slow drift on the reading. This is still under discussion with technical support at OSIL.

In addition to this it is also noted that the sample inlet tubing is missing a metal pipe from the cell when compared to the spare Autosal. OSIL have confirmed that this is a design feature difference between models. However, design severely bends the inflow tubing, possibly restricting flow to the cell.

It is suspected a new conductivity cell will be required and the Autosal recalibrated.

Overall, the servicing of the Autosal is very poor and this needs to be addressed with the provider.

Diagnosis and repair unlikely without return of unit to manufacturer or service personnel attending the vessel.

2.3.1.2 Autosal S/N 65763

When Autosal SN 65763 was brought up from the hold it was noted that the lamp for the bath was extremely hot. This was replaced with the lamp from the other Autosal. After a day it was noted that the heating lamps were not flashing on and off to regulate the bath temperature. This was investigated and the heat exhaust fan on the back of the unit was not plugged in as shown in Figure 11.

Figure 11:- Autosal S/N 65753 Disconnected Exhaust Fan

This was connected and the unit was operational.

It is noted that there is drift in the seawater standards from the start and end of a run which could cause issues on future cruises where higher accuracy salinity measurements are required.

Again, the quality of the servicing needs to be addressed with the provider.

2.3.1.3 Other Issues

In addition to this there are issues with keeping the temperature constant in the bio lab where the units are located and they have been set to run at 27 degrees C and require constant monitoring. This should be a consideration for future cruises through the tropics.

It was noted that temperature probes within the room were positioned close to the ceiling giving a false reading of the water temperatures of the samples. It is suggested that the temperature of sample or stock seawater is recorded to better assess whether samples should be run.

2.3.1.4 Manufacturer Recommendations

While fault finding on the Autosal units a phone call was made to OSIL by Aisling Smith (Lab Manager) to discuss the issues we were seeing on board with regard to the standards drifting at the start and end of the run. In short, the main fluctuation point is in the temperature which is hard to

maintain in the bio lab while going through the tropics. It is suggested that at cruise planning stage that this difficulty is raised to the PSO. It is recommended to install a temperature sensor inside the water bath to monitor temperature changes. This was looked into and there is a spare port on the Pico Temperature Data Logger although a higher accuracy immersion temperature probe would need to be purchased.

See below transcription of the call.

*/**********/*

Discussion with Westley from OSIL 17/10/2018

Email: seawater.chemist@osil.com

Tel: +44 2392 488240

Bath temperature

Ideally you want the bath temperature to be the same temperature as the sample. Ignore the manual stating that -2 to +4 is ok.

If it is not possible to have samples the same temperature it is better to have the bath 1 degree warmer than the sample temperature.

Look at the LTA cooling module-check this. You will need to check bath temperature at the start and end of runs. A change of 0.1 to 0.2 degree is a large change in temperature.

Changes within the bath of more than +/- 0.02 degree is enough to cause the instrument to drift and misreport.

The 'temperature' for the bath temp is a set point only. It is not the actual temp of the bath. Bath temp should be within 20 milli-degrees of the set point. If it is outside of this it will not report the correct conductivity.

Bulbs flashing: if it's struggling to maintain temp the bulbs will turn off for quite a period, rather than regular occasional sporadic flash.

If ptfe tubing is too close to any heating lamps it will cause sample to heat leading to a mis-read.

Tips from OSIL

Standardise at the start of each run.

A drift of 30 units over the course of a run is not ideal for high precision work. Advice would be to stop run.

Recommended that you record the start and end run bath temp. Also record the R value (the standardisation dial)

Bulbs flashing: if it is struggling to maintain temp the bulbs will turn off for quite a period, rather than regular occasional sporadic flash.

The instruments range of accuracy is +/- 0.02 psu, which is about 6 units.

Cleaning:

Ethanol decon mix is fine to use instead of methanol decon mix

OSIL fill the cell and then put it into an ultrasonic bath for at least 24 hours.

OSIL say that the cell is removed and cleaned at every service.

Using compressed air to blast it is fine. It won't damage cell.

Mechanical checks suggested:

Insert temperature probe into bath to be able to monitor over the duration of the run

Check that the LTA cooling module-check this.

Can use silicone to block for the flush manifold.

Metal section as the tubing (PTFE) enters the cell may be missing. This is not a mistake this is a new design.

Send a photo of the connection of the tube to OSIL.

Track the drain valve to cell to make sure there are no kinks on this, this can cause a pressure issue

If you want to make sure the ptfe is not leaking could you empty the cell and see if it refills with water from the bath

Is there a new edition of the manual? No there is only the 1970s manual available.

*/**********/*

2.3.2 Scintillation Counter

The Scintillation Counter had 2 engineers visit while alongside in Harwich for repairs. The unit is operational and has been used successfully throughout the cruise. There is a test procedure in place written by David Goodger under advice from the Perkin Elmer Engineers.

2.4 Notes for Acoustic Systems used

2.4.1 ADCP

The ADCP had issues with maintaining comms and would be stuck in the initialisation loop. This was fixed by IT and is being monitored.

2.4.2 EM122

The EM122 was used opportunistically for the cruise to provide a more reliable depth reading.

2.4.3 EK60/80

The EK60/80 was used opportunistically for the duration of the cruise and appears to have functioned correctly

2.4.4 K-Sync

K-Sync was used and appears to have functioned correctly

2.4.5 USBL

The USBL system was used for the duration of the cruise with a beacon being attached to the CTD and working well with a successful cast to 4000m with the exception of the security dongle for around 1 week. The issue with the security dongle was an expired time. This was investigated by IT. The problem was almost certainly caused by FusionUSBL being run with the PC date set in the past, which caused the security key to reset its start date. The date was incorrect because the USBL PC was rebooted with a flat CMOS battery and K9 was failing to sync the date\time. The IT tech replaced the CMOS battery, rebuilt the PC using a back-up image (to resolve K9 issue) and the security dongle was updated (by Sonardyne) with an expiration date of 01/12/2026. While the issues with the main dongle were ongoing the red emergency dongle was not easy to locate. The red dongle is stored in drawer 901 labelled AME - USBL manuals. It is also noted that there is no longer a hot swap spare for the USBL. This needs to be rectified.

2.4.6 EA600

The EA 600 was used and appears to have functioned correctly.

2.5 Notes about the Oceanlogger

There was a few issues with the Oceanlogger during the cruise.

2.5.1 Transmissometer End Brackets

Upon installation of the Transmissometer into the oceanlogger system it was noted that there was a leak on the water flow tubing end bracket. This was shown to be small cracks in the casing see below images in Figure 12 and Figure 13 and an additional bracket had a cracked end as shown in Figure 14. In addition to this another 2 broken end brackets were found.

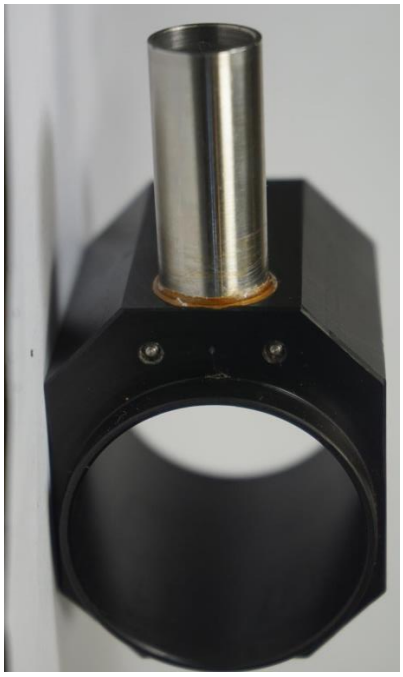


Figure 12:- Transmissometer end bracket hairline crack

Figure 13:- Transmissometer end bracket hairline crack

Figure 14:- Transmissometer bracket damaged end

2.5.2 SBE 45

On the 25/09/2018 it was noted that the SBE 45 SN 0072 was giving an incorrect salinity reading. This was investigated further and it was discovered the Conductivity sensor was giving incorrect readings when compared with calibration sheet. This was replaced with spare SBE 45 SN 0018 on the 25/09/2018 although this unit did not have the tubing connectors installed. These fittings were taken from the broken SBE 45. This resolved the issue.

2.5.3 Connection Issues

On the 01/10/2018 it was noted that the Chlorophyll values were giving incorrect readings. This was investigated and it was discovered that the Transmissometer and Fluorometer were connected into the wrong channels of the ocean logger this was correct at 19:40. To avoid this happening in the future the connectors have been labelled. In addition to this a suggestion would be to have “normal” values printed or added to the wiki to show what to expect which should highlight obviously erroneous values.

2.5.4 Fluorometer

During the investigation into the connection issues the Fluorometer was given a thorough clean and was noted that there was some growth within the sensor.

Notes about the CTD

Table 3:- CTD Cast Statistics

Basic Stats			
Number Of Casts	63		
Max Depth	4200	Min Depth	81
Cable Removed (m)	0	Number of Re-terminations (elect.)	Only on mobilisation

The CTD wire that has been in use has been cut and returned to the drum. A new CTD wire will be installed in the Falklands and will require re-termination on sailing.

2.5.5 CTD Deployment Procedure

Prior to deployment all bottles are cocked and the deionised water is vented from the T/C sensors. Pre-deployment technical tests are carried out on the LADCPs and are logged. The LADCP is then activated and starts logging. Once the deck crew and winch operator are ready, the CTD is lifted into the water and lowered to 10 m, where power is started and logging begins. It is held here until the operator sees the difference between T1 and T2 stabilize. This can take some time, especially if the air temperature and sea temperature are far apart. In some circumstances (mainly turbulent surface waters) it can be necessary to lower the CTD to 20 m or further, where the temperature is more stable. This is at the operator’s discretion. Once stable, the CTD is lifted to as near to the surface as the winch operator deems safe, then is lowered to the required depth or bottom without stopping. The bottom depth is an approximation from the best echo sounder available, commonly the EM122. If bottom depth is required then the altimeter will start working within 100 m of the sea bed and is used to stop approximately 10 m from the sea bed. From here some adjustment can be made to get closer, this is done at the operator’s discretion. Once the down-cast is complete, bottles are fired at requested depths, in order, deepest first. When each bottle is fired, 30 seconds are given to ensure that the independent standards thermometer has time to take a reading. Once on the surface the CTD is returned to the vessel and the C/T sensors are filled with deionised water to avoid damage. All data are backed up as soon as possible.

2.5.6 CTD Bottles

There were several issues with the 20 L bottles on this cruise.

2.5.6.1 Mobilisation

It was decided to use the new 20 L bottles that have been purchased for the SDA. This required substantially more time to setup than anticipated and very nearly caused there to be a major delay to the science programme due to not being setup on time. If this happens in the future the condition of these bottles needs to be communicated to the oncoming engineer to ensure sufficient time is allowed for setup. Also, the delivery of the bottles needs to be prioritised as they did not arrive on board until 1

day before sailing. In addition to this there is no spares package (O rings, stopcock drainage valves, and internal rubber springs) and only 2 spare 20 L bottles.

This shows some serious lack of planning when performing the mobilisation for the season.

2.5.6.2 Power Cord Tightening

The bottles themselves have a rubber power cord which has caused a great many leaks on the bottom end cap. This got to the point where there was not enough water left in the bottles for the scientists to collect. The bottles were tightened under advice from Ocean Test Equipment although this was not done properly due to not having the equipment to do so. It is advised to purchase a small spring balance to measure up to 36lbs to allow the force to be measured. The force that should be applied is 26-28 lbs. All bottles were adjusted over the course of the cruise as the internal springs failed to seal effectively. The manufacturer also recommended using a small amount of silicone when tying the new knot in the power cord this was not followed due to potential contamination issues within the bottle. This is something that may need to be discussed with the scientists at Cambridge.
Chief Scientist's notes: On occasion, more than half the rosette of 24 bottles leaked on the same cast. Basically, the rubber power cord used was not strong enough to keep the end caps in position with a 20 kg load of sweater above them, once the vent cap had been opened.

2.5.6.3 Manufacturer Recommendation

During conversation with the manufacturer it is recommended to replace the power cords at least yearly if not more frequently, therefore we need a good supply of spares on-board. It is also recommended to use stainless steel springs instead of the power cord as this minimises the chance of leaks which would be more important when performing dissolved gas sampling.

2.5.7 Frame Modifications

During the refit the BAS CTD frame was modified to allow the addition of 20 L bottles by increasing the height of the frame to allow the bottles to clear. Due to the extra length of the new 20 L bottles there were 2 bottles contacting the frame and not closing properly. See below images in Figure 15.

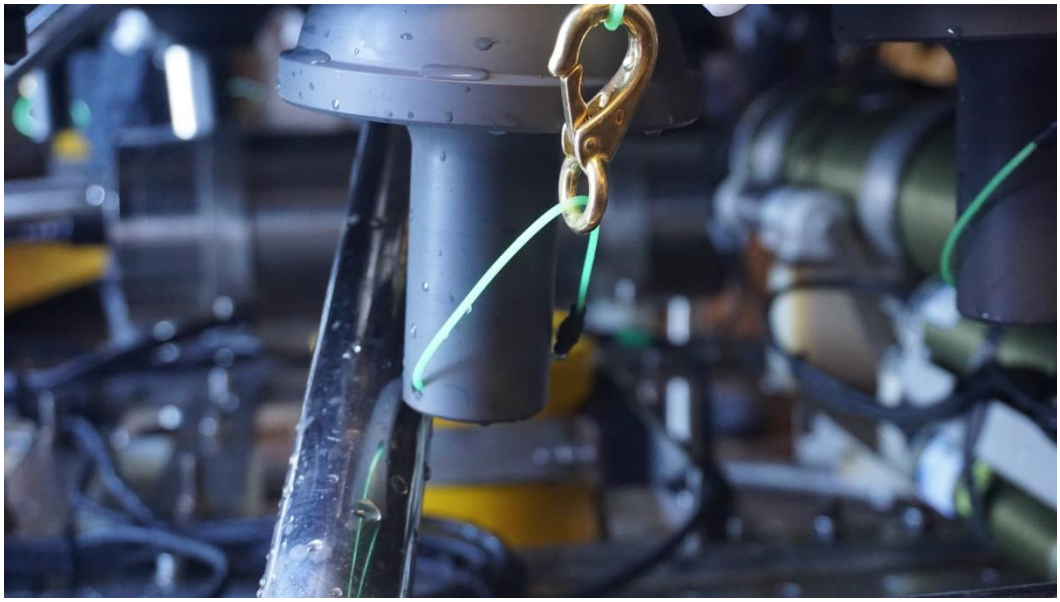


Figure 15:- 20 L CTD bottle contacting stainless steel frame strut

After discussions with Cambridge it was decided to install the spare CTD isolation washer which connects between the stainless steel frame and the aluminium rosette holder see below images in Figure 16 and Figure 17

Figure 16:- Installation of additional CTD isolation washer

Figure 17:- 20 L CTD bottle clearing stainless steel frame

This resolved the issue but leaves the spare frame without the isolation washer.

2.5.8 Additional Sensor Installation

2.5.8.1 Seabird ECO Fluorometer and Back Scatter (FLBB)

John Ballard from the University of San Diego provided a Seabird ECO Fluorometer and Back Scatter (FLBB) sensor to be installed on the CTD. The wrong cable was provided with the system but, fortunately there were sufficient tails available to make a subsea cable to connect the sensor. In addition to this no brackets were provided. This was manufactured on board see below images.

Figure 18:- Seabird Eco-FLBB installation

Figure 19:- Seabird Eco-FLBB installation

The sensor stopped giving data at 75 m on cast 041. This was investigated and an insulation fault was found on the short tail which could be causing it to short under pressure. This was replaced with another tail and worked for the remainder of the cruise. The tail has been kept to use as a deck test lead. It is clearly labelled.

2.5.8.2 Ixsea Acoustic Releases

For the deep cast to 4200m on cast 036, 2 x Ixsea Acoustic releases were attached to the CTD frame. This required removing bottles 5 and 21 and using some shackles and cable ties to attach.

2.6 Notes on Cable Counters

During the cruise the cable counter was running unreliably. This was investigated.

2.6.1 TX2 Fault

A faulty transmitter, TX2 S/N 50467 was found to have a range of maximum 27 m and average of 6 m compared to the 200 m expected range. It is suspected that the battery is on the way out. This unit is to be sent back to STR for investigation as the battery should last in excess of 6 years.

2.6.2 DTD 254 and antenna fault

In addition to the faulty transmitter there was also found to be an issue with one of the receivers. The combination of DTD 254 S/N 50591-TC and antenna STR-ANT1-418 S/N 50604-TC, when combined with the fully operational transmitter only produced a range of 37 m when compared to the other unit which achieved a range of 90 m (maximum we could achieve on-board). As the ranges normally used are less than 37 m it was decided this should be sufficient for this season, although this may need replacing if it continues to degrade in range.

2.6.3 Battery Charging of handheld counter in white box

During the investigation into the cable counters there were questions as to how well the handheld readers were getting charged on the dedicated chargers. After discussions with Cambridge it was decided to take the connector off the dedicated charger and connect it directly to the bench supply at 14.9V for charging to ensure that it was completely charged.

3 Additional work completed on cruise

3.1 PML Optics Rig

3.1.1 Subsea cables

During mobilisation two cables were required to be made for the optics rig. One tail was found to have a hairline crack in the connector which would have caused a fault. This was replaced with a spare CTD tail.

3.1.2 Chelsea battery pack

There were several problems with the Chelsea battery packs

3.1.2.1 Chelsea battery pack S/N 182042

This battery pack was not taking any charge. It was opened to investigate and the batteries were found to be flooded as shown in Figure 20. These were removed and disposed of.

Figure 20:- Chelsea Battery Pack S/N 182042 flooded internals with corroded batteries

Figure 21:- Chelsea Battery Pack S/N 182042 Replacement charging components

3.1.2.2 Chelsea battery pack S/N 180241

The Chelsea battery pack provided was not taking a full charge and the unit was only working at the start of the optics cast. This was investigated and it was found to be several factors.

3.1.2.2.1 Charging Cable

The charging cable provided had previous salt water ingress and was badly corroded on the inside. This was replaced with a new one.

3.1.2.2.2 Battery pack

On one unit the battery pack PCB was receiving the correct voltage from the PSU but was not regulating the voltage to the batteries for charging. This was replaced with 6 diodes (IN5404) to allow safe charging of the batteries from a bench power supply set to 17.8V as shown in **Error! Reference ource not found.**. A new charging cable was provided with a DC power plug and socket.

3.1.3 SBE 5T Pump

In the initial deployments the data were not as expected. It was traced down to a faulty pump. A spare CTD SBE 5T pump was provided and a subsea cable manufactured for this.

3.2 PML Picarro installed in the mail room

During the cruise through the tropics the temperature in the mail room was approximately 50°C with the instrumentation running up to 60°C, although the equipment is only rated to 40°C. Three rack fans were provided for cooling and this assisted the situation as shown in Figure 22. They are still currently installed and should be reclaimed at the end of the season on demobilisation.

Figure 22:- Installation of additional fans to assist cooling of mail room Picarro

3.3 University of East Anglia particle vacuum

The UEA particle vacuum pump developed a faulty motor. The unit was opened. Some damage was observed on the capacitor wire and the mounting plate was bent. See below images in Figure 23 and Figure 24. This was replaced with a spare motor.

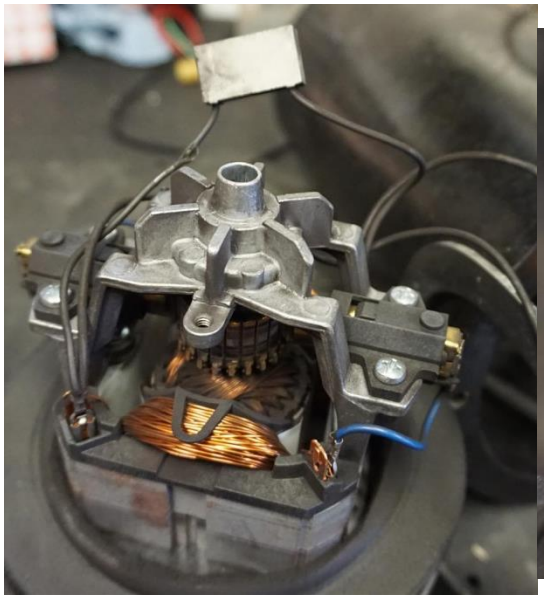


Figure 23:- UEA vacuum motor

Figure 24:- UEA damaged capacitor wire

4 Workshop Equipment

4.1 Oscilloscopes

During the cruise a dual channel oscilloscope was required to perform some testing on the Autosal units. This was not available in the workshop as both oscilloscopes are not functioning correctly.

4.1.1 Tektronix TDS 3012B

The Tektronix oscilloscope only has 1 functional channel (2). Channel 1 does not work correctly. This should be repaired/replaced.

4.1.2 Fluke scope meter 190-062

The Fluke scope meter was out of battery and the charger could not be located. A replacement charger has been requested.

4.2 Drills

A new drill was purchased for the season. It is located on the floor by the door.

5 AME Department notes

5.1 Pre-cruise tasks

Task	Status
Download AME_Eng/Platform_Specific/JCR	N
Check cruise planning meeting notes	N
Number of hours hand over with previous ship's AME Engineer	N

5.2 Daily & weekly tasks

Task	Frequency	Status
Sanity check the Oceanlogger data	Daily	N
Check the Following Fans: Oceanlogger Acoustic Rack Seapath EM122 (Tween) Topas (Tween)	Daily	Y
Mega test CTD cable	Weekly	Y
Clean Underway System	Weekly	N

5.3 End of cruise checks

Task	Status
XBT left in cage, in a suitable state	Y
The salinity bottles have been cleaned, if used	Y
CTD left in suitable state - Ducts cleaned with Triton and deionised water, blanking plugs installed and system washed with water	Y
CTD slip rings have been cleaned	Y/N
Office is tidy, with manuals and files returned and items stowed for sea	Y
Clean the following fans: Oceanlogger Acoustic Rack Seapath EM122 (Tween) Topas (Tween)	Y

5.4 Items to be purchased

Supplier	Item	Quantity	Use
RS	TE Connectivity Cable Sleeve Kit Refill CGAT Series, 3:1 Shrink Ratio, 1 piece	3	Cable repairs and lanyard making
RS	ON Semi 1N5404G Diode, 400V 3A, 2-Pin DO-201AD	10	Diodes used for power regulation
Ocean Test Equipment	Niskin 20L bottles stopcocks with O'Rings	26	Spare for bottles onboard
Ocean Test Equipment	Niskin 20L bottles Natural Rubber Internal Spring	26	Spare for bottles onboard
Ocean Test Equipment	Niskin 20L bottles End Cap O'Rings	52	Spare for bottles onboard

BAS Cambridge	SBE 45	1	Spare for onboard
OSIL	Autosal 8400B light bulb for chamber	1	Spare for onboard
Planet Ocean?	Impulse 2 pin female with locator pin tail 2m length	2	Spare for seabird pump used 2 to make cables
Planet Ocean?	Impulse 6 pin female tail 2m length	4	
RS	RS Pro Black 3:1, Heat Shrink Tubing 19mm Sleeve Dia. x 1.2m Length	2	Cable repairs
RS	RS Pro Black Nylon Cable Tie, 300mm x 4.8 mm	2	Cable management
RS	RS Pro Black Nylon Cable Tie, 150mm x 3.6 mm	2	Cable management
	Fluke Scopemeter 190-062 charger	1	

5.5 Additional notes and changes/future work

The CTD wire is to be changed over to a new one in Stanley. Therefore, a complete mechanical and electrical re-termination will be required during mobilisation/sailing.

The red T Count Transmitter S/N 50467-TC is to be returned to STR for investigation once the replacement unit has reached the vessel.

SOG Mooring Recovery and Deployment

Ian Murdoch
Ocean Engineering Group, National Marine Facilities, UK

Recovery of 2017 SOG Mooring

Release Position:

18^{o} 32.700' S

25^{o} 04.800' W

Monday 15th October at 06.30 GMT, recovery operations of 2017 SOG Mooring began. When the ship was in position all echo sounders were switched off or put into passive mode to prevent interference when using deck unit and transducer IXSEA TT801. With an instant response back from the acoustic release I had a range of 5271.0m at 07:16. When the mooring was released, it was ranged whilst climbing through the water column at 1 minute intervals to determine a rate of ascent and estimated surface time. The mooring climbed at a rate of 25 m per minute. This rate is very slow for the amount of buoyancy deployed on the mooring. At this point I assumed that some of the buoyancy spheres might have imploded at depth. The mooring was ranged every five minutes thereafter and continued to rise at a slow rate increasing to 30 m per minute.

The mooring was first sighted by the bridge at 09:04, the bridge observed two packages on the surface at a range of 1000 m off the bow at position 18° 32.15' S, 025° 05.3' W

At this point it was obvious that the deeper buoyancy spheres had imploded.

Once the hydrophone transducer was inboard the ship moved into position ready to grapple the top recovery line. The recovery buoy was removed and mooring winch rope attached at 09:31am. Whilst the ship slowly moved ahead the slack rope was heaved until the mooring line towed aft. The Billings float was recovered to the deck at 09:42. The two sediment traps came to the surface in good condition with no signs of damage and samples all attached. Mooring recovery went very smoothly using a combination of JCR deck mooring winch, aft gantry and articulating arm. The recovery was complete, with the acoustic release on deck at 11:09, in position 18° 32.15' S – 025° 05.5' W. Instruments were fresh water-rinsed and stowed safely until a convenient time to stop data logging.

Table 1: Components of the 2017 SOG mooring with times recovered

Instrument	Serial Number	Recovery Time (GMT)
Novatech Light & Argos	A08-015 / A02-017	09:42
AQD Current Meter	13585	10:02
Parflux Sediment Trap	11804-04	10:02
AQD Current Meter	13569	10:09
Parflux Sediment Trap	12168-02	10:09
SBE Moored CTD	13244	11:00
Acoustic Release AR861	1469	11:09

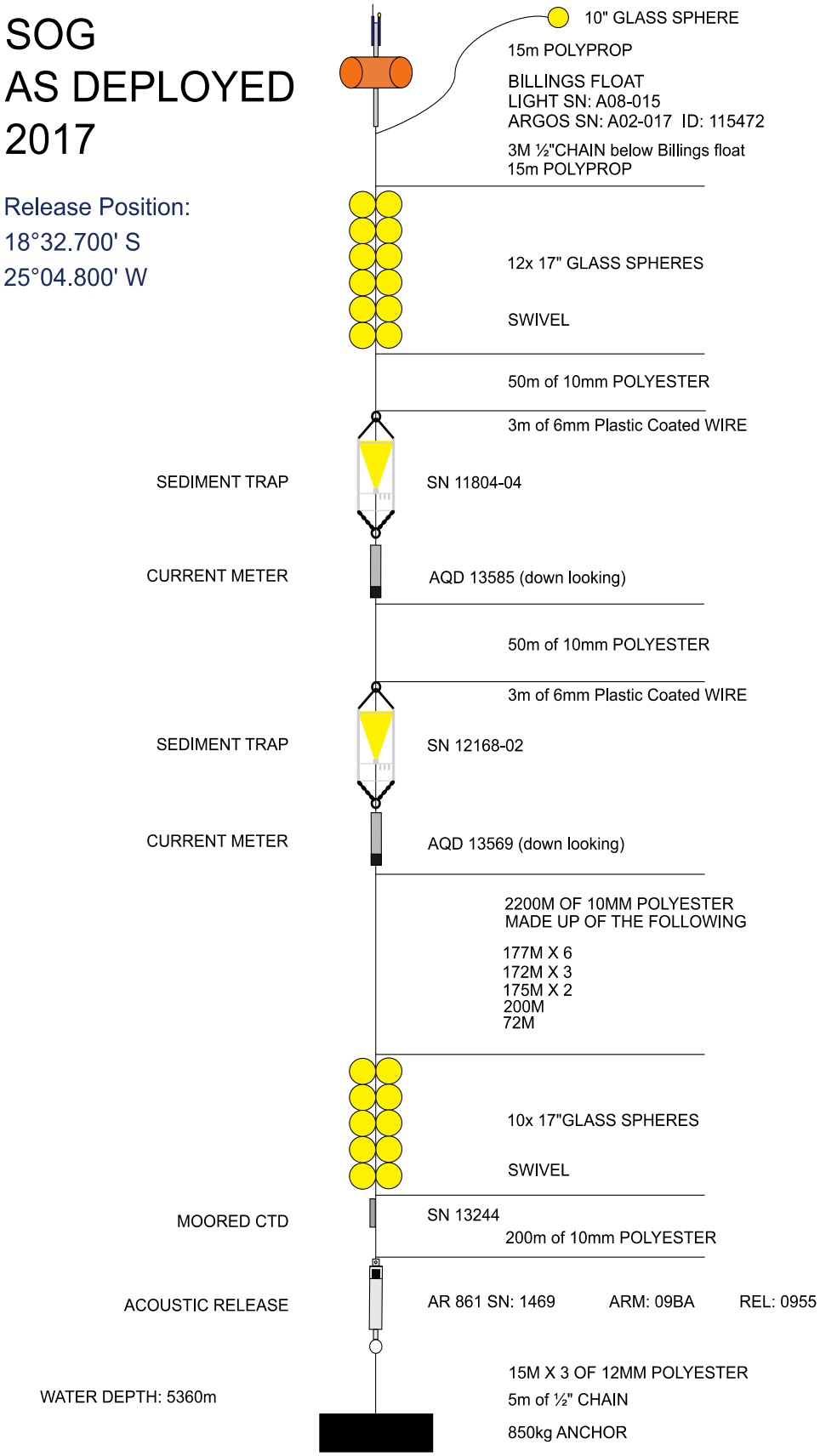


Figure 1: SOG mooring as deployed in 2017

Figure 2: Billings Float Recovered.

Figure 3: Sediment Trap Recovery.

Figure 4: Imploded buoyancy spheres.

Deployment of 2018 SOG Mooring

All mooring ropes, links and shackles were wound onto the JCR mooring winch with the bottom ropes first, finishing with the top. A rope reeling stand was used to support reels whilst winding. Buoyancy spheres, sediment traps, instruments and the acoustic release were made ready. Deployment of the 2018 mooring began at 14:25 in position 18^{o} 34.75' S, 025^{o} 05.1' W. Slowly moving ahead, the mooring recovery Billings float was streamed aft and tension gradually increased to allow the top pack of buoyancy floats to be deployed. The ship's aft Gilson Winch held a sea catch on a wire through the aft gantry's center sheave, connected through the lifting bridal to safely and effectively deploy the sediment traps and Nortek current meters in a vertical position. The lower buoyancy was changed on AMT28 in comparison to previous years. On this deployment, to prevent imploding buoyancy spheres at the deeper depth,s a 40 inch diameter Syntactic Buoy was used.

Table 2 : Components of the 2018 SOG mooring with times that they entered the water

Instrument	Serial Number	Time in the water (GMT)
Light & Argos	Y01-015 / CO2-048	14:25
Parflux Sediment Trap	12432-04 (SOG-A)	14:40
AQD Current Meter	11990	14:40
Parflux Sediment Trap	12432-03 (SOG-B)	15:00
AQD Current Trap	11992	15:00
40'' Syntactic Buoyancy	J18048-003	16:12
SBE 37 CTD	13242	16:12
Acoustic Release AR861	2253	16:20

Anchor released: 16:32

Position: 18^{o} 32.70' S, 025^{o} 04.81' W

EA600 Depth: 5289m

The Mooring fell to the seabed at an average rate of 100 m per minute. The releases came to a stop and depth stabilized at 17:19 at 5310 m Depth.

Table 3: Instrument set up details

```
Deployment   : SOG_B
Current time : 15/10/2018 11:58:42
Start at     : 15/10/2018 18:00:00
Comment:
SOG_B CM BELOW TRAP B
---------------------------------------
Measurement interval  (s) : 1800
Average interval      (s) : 60
Blanking distance     (m) : 0.50
Measurement load      (%) : 4
Power level               : HIGH
Diagnostics interval(min) : 720:00
Diagnostics samples       : 20
Compass upd. rate     (s) : 1
Coordinate System         : ENU
Speed of sound      (m/s) : MEASURED
Salinity            (ppt) : 35
Analog input 1            : NONE
Analog input 2            : NONE
Analog input power out    : DISABLED
Raw magnetometer out      : OFF
File wrapping             : OFF
TellTale                  : OFF
AcousticModem             : OFF
Serial output             : OFF
Baud rate                 : 9600
---------------------------------------
Assumed duration   (days) : 550.0
Battery utilization   (%) : 89.0
Battery level         (V) : 13.7
Recorder size        (MB) : 9
Recorder free space  (MB) : 8.973
Memory required      (MB) : 2.0
Vertical vel. prec (cm/s) : 1.4
Horizon. vel. prec (cm/s) : 0.9
---------------------------------------
Instrument ID             : AQD11992
Head ID                   : A6L 6934
Firmware version          : 3.37
---------------------------------------
Aquadopp Deep Water Version 1.40.16
```

```
Deployment   : SOG_A
Current time : 15/10/2018 11:54:50
Start at     : 15/10/2018 18:00:00
Comment:
SOG_A CM BELOW TRAP A
---------------------------------------
Measurement interval  (s) : 1800
Average interval      (s) : 60
Blanking distance     (m) : 0.50
Measurement load      (%) : 4
Power level               : HIGH
Diagnostics interval(min) : 720:00
Diagnostics samples       : 20
Compass upd. rate     (s) : 1
Coordinate System         : ENU
Speed of sound      (m/s) : MEASURED
Salinity            (ppt) : 35
Analog input 1            : NONE
Analog input 2            : NONE
Analog input power out    : DISABLED
Raw magnetometer out      : OFF
File wrapping             : OFF
TellTale                  : OFF
AcousticModem             : OFF
Serial output             : OFF
Baud rate                 : 9600
---------------------------------------
Assumed duration   (days) : 550.0
Battery utilization   (%) : 89.0
Battery level         (V) : 13.7
Recorder size        (MB) : 9
Recorder free space  (MB) : 8.973
Memory required      (MB) : 2.0
Vertical vel. prec (cm/s) : 1.4
Horizon. vel. prec (cm/s) : 0.9
---------------------------------------
Instrument ID             : AQD11990
Head ID                   : A6L 6931
Firmware version          : 3.37
---------------------------------------
Aquadopp Deep Water Version 1.40.16
```

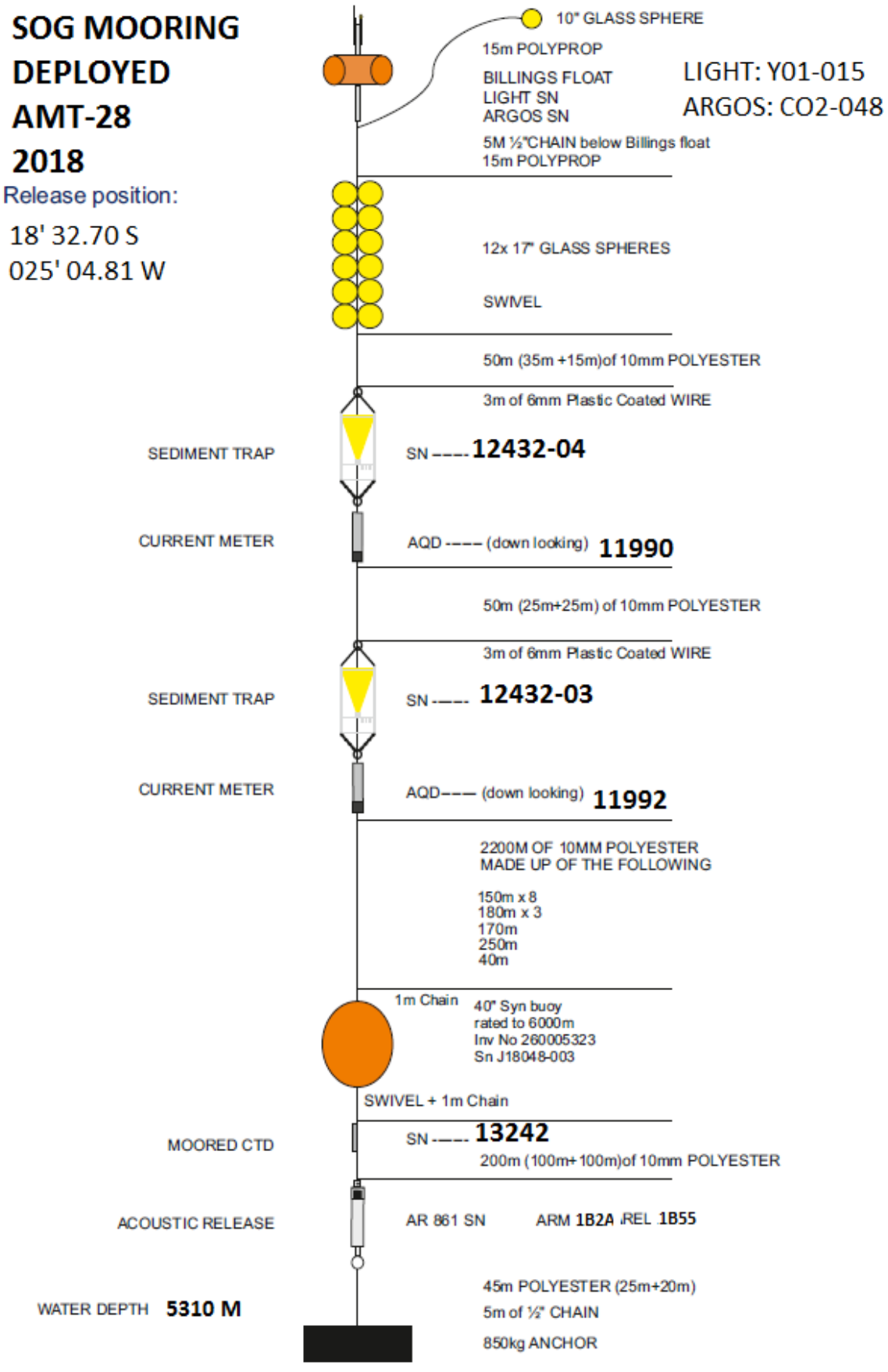


Figure 5: SOG mooring as deployed on AMT28 in 2018

Appendix 1: Non-toxic Seawater Supply System Log

Date	Time (GMT)	Pump	Filter in use	Probe position	Event	Remarks
25-09-18	0700	Fwd	2	Mid	Started System	
27-09-18	0700	Fwd	1	Mid	Swapped strainers	One small fish in strainer
29-09-18	0700	Fwd	2	Mid	Swapped strainers	
01-10-18	1600	Fwd	1	Mid	Swapped strainers	
04-10-18	1600	Fwd	2	Mid	Swapped strainers	
08-10-18	0900	Fwd	1	Mid	Swapped strainers	Kelp in strainer
12-10-18	1100	Fwd	2	Mid	Swapped strainers	Kelp in strainer
16-10-18	0900	Fwd	1	Mid	Swapped strainers	
19-10-18	0900	Aft	2	Down	Swapped strainers, lowered probe	Low flow rate in chem lab
23-10-18	0800	Aft	1	Down	Swapped strainers	
26-10-18	0900	Aft	1	Mid	Lifted probe to Mid position	
26-10-18	1400	Aft	2	Mid	Swapped strainers	
28-10-18	2115	Aft	2	Up	Turned off system and closed valve	

Appendix 2: AMT28 Log of Events.

* Lat and Lon coordinate reference system is WGS 84 throughout this report

Start date and time (GMT)	End date and time (GMT)	Gear	Activity	Station	Event No.	Start *Lat (+ve N)	Start *Lon (+ve E)	End Lat (+ve N)	End Lon (+ve E)	Comments
25/09/2018 12:32	25/09/2018 13:06	CTD	CTD001	1	1	49.6381	-5.5016	49.6381	-5.5016	Ship's time is GMT+1 (BST)
25/09/2018 12:42	25/09/2018 13:05	OPTICS RIG	OPTICS 001	1	2	49.6381	-5.5016	49.6381	-5.5016	
25/09/2018 12:49	25/09/2018 13:02	SODS FLOAT	SODS001	1	3	49.6381	-5.5016	49.4498	-6.0478	
26/09/2018 03:34	26/09/2018 04:07	CTD	CTD002	2	4	48.4694	-8.8366	48.4694	-8.8366	
26/09/2018 03:38	26/09/2018 03:57	BONGO NET	BONGO 001	2	5	48.4694	-8.8366	48.4694	-8.8366	
26/09/2018 03:39	26/09/2018 04:00	SODS FLOAT	SODS002	2	6	48.4694	-8.8366	48.4694	-8.8366	
26/09/2018 12:07	26/09/2018 12:43	OPTICS RIG	OPTICS 002	3	7	47.9013	-10.3814	47.9012	-10.3814	
26/09/2018 12:10	26/09/2018 12:55	CTD	CTD003	3	8	47.9013	-10.3814	47.9012	-10.3814	
26/09/	26/09/	SODS	SODS003	3	9	47.9013	-10.3814	47.9012	-10.3814	

2018 12:12	2018 12:34	FLOAT								
27/09/ 2018 03:29	27/09/ 2018 03:53	BONGO NET	BONGO 002	4	10	46.0291	-12.7325	46.0291	-12.7325	
27/09/ 2018 03:30	27/09/ 2018 04:16	CTD	CTD004	4	11	46.0291	-12.7326	46.0291	-12.7325	
27/09/ 2018 03:30	27/09/ 2018 03:53	SODS FLOAT	SODS004	4	12	45.9832	-12.7747	46.0291	-12.7325	
27/09/ 2018 12:04	27/09/ 2018 12:57	CTD	CTD005	5	13	44.9786	-13.5894	44.9786	-13.5894	
27/09/ 2018 12:06	27/09/ 2018 12:42	OPTICS RIG	OPTICS 003	5	14	44.9786	-13.5894	44.9786	-13.5894	
27/09/ 2018 12:12	27/09/ 2018 12:34	SODS FLOAT	SODS005	5	15	44.9786	-13.5894	44.9786	-13.5894	
27/09/ 2018 12:26	N/A	BALLOON	BALLOON 001	5	16	44.9786	-13.5894	N/A	N/A	
28/09/ 2018 03:33	28/09/ 2018 04:21	CTD	CTD006	6	17	42.9675	-15.2134	42.9647	-15.2116	
28/09/ 2018 03:35	28/09/ 2018 04:08	BONGO NET	BONGO 003	6	18	42.9666	-15.2128	42.9307	-15.2410	
28/09/ 2018 03:40	28/09/ 2018 04:03	SODS FLOAT	SODS006	6	19	42.9656	-15.2122	42.9647	-15.2116	

28/09/2018 12:00	28/09/2018 12:40	OPTICS RIG	OPTICS 004	7	20	41.9117	-16.0363	41.9117	-16.0363	
28/09/2018 12:02	28/09/2018 12:50	CTD	CTD007	7	21	41.9117	-16.0363	41.6448	-16.2476	
28/09/2018 12:09	N/A	BALLOON	BALLOON 002	7	22	41.9117	-16.0363	N/A	N/A	
28/09/2018 12:10	28/09/2018 12:31	SODS FLOAT	SODS007	7	23	41.9117	-16.0363	41.9117	-16.0363	
29/09/2018 03:29	29/09/2018 04:22	CTD	CTD008	8	24	39.7193	-17.7162	39.6845	-17.7375	
29/09/2018 03:30	29/09/2018 03:56	BONGO NET	BONGO 004	8	25	39.7193	-17.7161	39.7193	-17.7162	
29/09/2018 03:36	29/09/2018 03:56	SODS FLOAT	SODS008	8	26	39.7193	-17.7161	39.7193	-17.7162	
29/09/2018 11:57	29/09/2018 12:37	OPTICS RIG	OPTICS 005	9	27	38.6309	-18.5257	38.6309	-18.5257	
29/09/2018 12:00	29/09/2018 12:52	CTD	CTD009	9	28	38.6309	-18.5257	38.6308	-18.5257	
29/09/2018 12:08	29/09/2018 12:31	SODS FLOAT	SODS009	9	29	38.6309	-18.5257	38.6309	-18.5257	
29/09/2018	N/A	BALLOON	BALLOON 003	9	30	38.6308	-18.5257	N/A	N/A	

12:14										
29/09/2018 12:40	N/A	SKY PAN	SKY001	9	31	38.6308	-18.5257	N/A	N/A	
30/09/2018 04:27	30/09/2018 04:55	BONGO NET	BONGO 005	10	32	36.4139	-20.1215	36.4139	-20.1215	Ships time is GMT (clocks back 1 hour)
30/09/2018 04:27	30/09/2018 05:20	CTD	CTD010	10	33	36.4139	-20.1215	36.4139	-20.1214	
30/09/2018 04:30	30/09/2018 04:52	SODS FLOAT	SODS010	10	34	36.4139	-20.1215	36.4139	-20.1215	
30/09/2018 12:55	30/09/2018 13:35	OPTICS RIG	OPTICS 006	11	35	35.3020	-20.9152	35.3020	-20.9152	
30/09/2018 13:01	30/09/2018 13:50	CTD	CTD011	11	36	35.3020	-20.9152	35.3020	-20.9152	
30/09/2018 13:06	30/09/2018 13:29	SODS FLOAT	SODS011	11	37	35.3020	-20.9152	35.3020	-20.9152	
30/09/2018 13:18	N/A	BALLOON	BALLOON 004	11	38	35.3020	-20.9152	N/A	N/A	
30/09/2018 13:54	N/A	SKY PAN	SKY002	11	39	35.3020	-20.9152	N/A	N/A	
01/10/2018 04:27	01/10/2018 04:54	BONGO NET	BONGO 006	12	40	33.0469	-22.1368	33.0469	-22.1368	

01/10/2018 04:30	01/10/2018 05:27	CTD	CTD012	12	41	33.0470	-22.1368	33.0469	-22.1368	
01/10/2018 04:37	01/10/2018 04:57	SODS FLOAT	SODS012	12	42	33.0469	-22.1368	33.0469	-22.1368	
01/10/2018 13:02	01/10/2018 13:41	OPTICS RIG	OPTICS 007	13	43	31.9240	-22.7102	31.9240	-22.7102	
01/10/2018 13:04	01/10/2018 14:01	CTD	CTD013	13	44	31.9240	-22.7102	31.9240	-22.7102	
01/10/2018 13:12	01/10/2018 13:36	SODS FLOAT	SODS013	13	45	31.8140	-22.7469	31.9240	-22.7102	
01/10/2018 13:16	N/A	BALLOON	BALLOON 005	13	46	31.9240	-22.7102	N/A	N/A	
02/10/2018 04:34	02/10/2018 05:00	BONGO NET	BONGO 007	14	47	29.4883	-23.9325	29.4883	-23.9325	
02/10/2018 04:34	02/10/2018 05:27	CTD	CTD014	14	48	29.4883	-23.9325	29.4883	-23.9324	
02/10/2018 04:36	02/10/2018 05:00	SODS FLOAT	SODS014	14	49	29.4883	-23.9325	29.4883	-23.9325	
02/10/2018 10:51	02/10/2018 13:39	CTD	CTD015	15	50	28.6091	-24.3609	28.6091	-24.3609	
02/10/2018	N/A	SKY PAN	SKY003	15	51	28.6091	-24.3609	N/A	N/A	

11:50										
02/10/ 2018 12:54	02/10/ 2018 13:35	OPTICS RIG	OPTICS 008	15	52	28.6091	-24.3608	28.6091	-24.3609	
02/10/ 2018 13:08	02/10/ 2018 13:30	SODS FLOAT	SODS015	15	53	28.6091	-24.3609	28.6091	-24.3609	
02/10/ 2018 13:34	N/A	BALLOON	BALLOON 006	15	54	28.6091	-24.3609	N/A	N/A	
03/10/ 2018 04:29	03/10/ 2018 04:54	BONGO NET	BONGO 008	16	55	26.2038	-25.5211	26.2038	-25.5211	
03/10/ 2018 04:31	03/10/ 2018 04:54	SODS FLOAT	SODS016	16	56	26.2038	-25.5211	26.2038	-25.5211	
03/10/ 2018 04:32	03/10/ 2018 05:27	CTD	CTD016	16	57	26.2038	-25.5211	26.2038	-25.5211	
03/10/ 2018 12:59	03/10/ 2018 13:52	CTD	CTD017	17	58	25.0577	-26.0568	25.0577	-26.0568	
03/10/ 2018 13:04	03/10/ 2018 13:42	OPTICS RIG	OPTICS 009	17	59	25.0577	-26.0568	25.0577	-26.0568	
03/10/ 2018 13:11	N/A	BALLOON	BALLOON 007	17	60	25.0577	-26.0568	N/A	N/A	
03/10/ 2018 13:17	03/10/ 2018 13:43	SODS FLOAT	SODS017	17	61	25.0577	-26.0568	25.0577	-26.0568	
04/10/	04/10/	BONGO	BONGO	18	62	22.5997	-27.2134	22.5260	-27.2376	

2018 04:27	2018 04:56	NET	009							
04/10/ 2018 04:32	04/10/ 2018 04:57	SODS FLOAT	SODS018	18	63	22.5997	-27.2134	22.5997	-27.2134	
04/10/ 2018 04:34	04/10/ 2018 05:27	CTD	CTD018	18	64	22.5997	-27.2133	22.5997	-27.2134	
04/10/ 2018 12:55	04/10/ 2018 13:32	OPTICS RIG	OPTICS 010	19	65	21.4472	-27.7454	21.4472	-27.7453	
04/10/ 2018 13:00	04/10/ 2018 13:49	CTD	CTD019	19	66	21.4472	-27.7453	21.4472	-27.7454	
04/10/ 2018 13:05	04/10/ 2018 13:27	SODS FLOAT	SODS019	19	67	21.4472	-27.7453	21.4472	-27.7453	
04/10/ 2018 13:06	N/A	BALLOON	BALLOON 008	19	68	21.4472	-27.7453	N/A	N/A	
04/10/ 2018 13:56	N/A	SKY PAN	SKY004	19	68B	21.4472	-27.7454	N/A	N/A	
05/10/ 2018 04:32	05/10/ 2018 04:55	BONGO NET	BONGO 010	20	69	19.0778	-28.8168	19.0778	-28.8167	
05/10/ 2018 04:34	05/10/ 2018 04:56	SODS FLOAT	SODS020	20	70	19.0778	-28.8168	19.0778	-28.8168	
05/10/ 2018 04:36	05/10/ 2018 05:22	CTD	CTD020	20	71	19.0778	-28.8168	18.8081	-28.8392	

05/10/2018 12:54	05/10/2018 13:32	OPTICS RIG	OPTICS 011	21	72	17.7473	-28.9303	17.7474	-28.9302	
05/10/2018 13:00	05/10/2018 13:53	CTD	CTD021	21	73	17.7473	-28.9302	17.7474	-28.9302	
05/10/2018 13:04	05/10/2018 13:26	SODS FLOAT	SODS021	21	74	17.7473	-28.9302	17.7473	-28.9302	
05/10/2018 13:27	N/A	BALLOON	BALLOON 009	21	75	17.7473	-28.9302	N/A	N/A	
06/10/2018 04:30	06/10/2018 04:56	BONGO NET	BONGO0 11	22	76	15.0761	-28.6126	15.0761	-28.6127	
06/10/2018 04:32	06/10/2018 04:56	SODS FLOAT	SODS022	22	77	15.0761	-28.6126	15.0761	-28.6127	
06/10/2018 04:37	06/10/2018 05:32	CTD	CTD022	22	78	15.0761	-28.6126	15.0761	-28.6127	
06/10/2018 12:56	06/10/2018 13:32	OPTICS RIG	OPTICS 012	23	79	13.8122	-28.2946	13.8122	-28.2946	
06/10/2018 13:00	06/10/2018 13:49	CTD	CTD023	23	80	13.8122	-28.2946	13.8122	-28.2946	
06/10/2018 13:05	06/10/2018 13:27	SODS FLOAT	SODS 023	23	81	13.8122	-28.2946	13.8122	-28.2946	
06/10/2018	N/A	BALLOON	BALLOON 010	23	82	13.8122	-28.2945	N/A	N/A	

13:11										
07/10/2018 04:31	07/10/2018 04:56	BONGO NET	BONGO 012	24	83	11.4470	-27.7087	11.4470	-27.7087	
07/10/2018 04:34	07/10/2018 04:57	SODS FLOAT	SODS024	24	84	11.4470	-27.7087	11.4470	-27.7087	
07/10/2018 04:35	07/10/2018 05:20	CTD	CTD024	24	85	11.4470	-27.7087	11.4470	-27.7087	
07/10/2018 12:55	07/10/2018 13:30	OPTICS RIG	OPTICS 013	25	86	10.0983	-27.2939	10.0983	-27.2938	
07/10/2018 12:58	07/10/2018 13:34	CTD	CTD025	25	87	10.0982	-27.2938	10.0983	-27.2938	
07/10/2018 13:06	07/10/2018 13:27	SODS FLOAT	SODS025	25	88	10.0982	-27.2938	10.0983	-27.2938	
07/10/2018 13:17	N/A	BALLOON	BALLOON 011	25	89	10.0983	-27.2938	N/A	N/A	
07/10/2018 19:49	07/10/2018 19:54	ARGO FLOAT RECOVERY	ARGO RECOVER 001	26	90	8.8703	-26.9641	8.8701	-26.9639	
08/10/2018 04:30	08/10/2018 04:58	BONGO NET	BONGO 013	27	91	7.4713	-26.6501	7.4713	-26.6501	
08/10/2018 04:33	08/10/2018 04:58	SODS FLOAT	SODS026	27	92	7.4713	-26.6501	7.4713	-26.6501	

08/10/2018 04:36	08/10/2018 05:25	CTD	CTD026	27	93	7.4713	-26.6501	7.4713	-26.6501	
08/10/2018 12:56	08/10/2018 13:34	OPTICS RIG	OPTICS 014	28	94	6.2561	-26.3800	6.2560	-26.3800	
08/10/2018 13:00	08/10/2018 13:50	CTD	CTD027	28	95	6.2560	-26.3800	6.2560	-26.3800	
08/10/2018 13:04	08/10/2018 13:25	SODS FLOAT	SODS027	28	96	6.2560	-26.3799	6.2560	-26.3800	
08/10/2018 13:10	N/A	BALLOON	BALLOON 012	28	97	6.2560	-26.3800	N/A	N/A	
09/10/2018 04:33	09/10/2018 04:58	BONGO NET	BONGO 014	29	98	3.8078	-25.8358	3.8078	-25.8358	
09/10/2018 04:37	09/10/2018 04:58	SODS FLOAT	SODS028	29	99	3.8078	-25.8358	3.8078	-25.8358	
09/10/2018 04:38	09/10/2018 05:28	CTD	CTD028	29	100	3.8078	-25.8358	3.8077	-25.8358	
10/10/2018 04:42	10/10/2018 05:38	CTD	CTD029	30	101	0.0006	-24.9991	0.0020	-24.9925	
10/10/2018 04:44	10/10/2018 05:15	BONGO NET	BONGO 015	30	102	0.0005	-24.9992	0.0020	-24.9956	
10/10/2018	10/10/2018	SODS FLOAT	SODS029	30	103	0.0005	-24.9992	0.0013	-24.9973	

04:45	05:07									
10/10/ 2018 12:57	10/10/ 2018 13:33	OPTICS RIG	OPTICS 015	31	104	-1.1518	-24.9906	-1.1508	-24.9857	
10/10/ 2018 13:00	10/10/ 2018 13:53	CTD	CTD030	31	105	-1.1518	-24.9906	-1.1505	-24.9824	
10/10/ 2018 13:05	10/10/ 2018 13:28	SODS FLOAT	SODS030	31	106	-1.1518	-24.9906	-1.1509	-24.9865	
10/10/ 2018 13:15	N/A	BALLOON	BALLOON 013	31	107	-1.1512	-24.9888	N/A	N/A	
10/10/ 2018 13:55	N/A	SKY PAN	SKY005	31	108	-1.1504	-24.9821	N/A	N/A	
11/10/ 2018 04:33	11/10/ 2018 05:00	BONGO NET	BONGO 016	32	109	-3.6918	-24.9774	-3.6894	-24.9792	
11/10/ 2018 04:34	11/10/ 2018 05:00	SODS FLOAT	SODS031	32	110	-3.6918	-24.9774	-3.6894	-24.9792	
11/10/ 2018 04:37	11/10/ 2018 05:27	CTD	CTD031	32	111	-3.6916	-24.9776	-3.6876	-24.9809	
11/10/ 2018 12:57	11/10/ 2018 13:55	CTD	CTD032	33	112	-5.2562	-24.9714	-4.9846	-24.9732	
11/10/ 2018 12:59	11/10/ 2018 13:36	OPTICS RIG	OPTICS 016	33	113	-4.9846	-24.9732	-4.9846	-24.9732	
11/10/	11/10/	SODS	SODS032	33	114	-4.9846	-24.9732	-4.9846	-24.9732	

2018 13:05	2018 13:27	FLOAT								
11/10/ 2018 13:15	N/A	BALLOON	BALLOON 014	33	115	-4.9847	-24.9732	N/A	N/A	
12/10/ 2018 04:36	12/10/ 2018 05:05	BONGO NET	BONGO 017	34	116	-7.5488	-24.9572	-7.5486	-24.9588	
12/10/ 2018 04:37	12/10/ 2018 05:29	CTD	CTD033	34	117	-7.5487	-24.9573	-7.5488	-24.9601	
12/10/ 2018 04:42	12/10/ 2018 05:06	SODS FLOAT	SODS033	34	118	-7.5487	-24.9575	-7.5486	-24.9589	
12/10/ 2018 12:56	12/10/ 2018 13:34	OPTICS RIG	OPTICS 017	35	119	-8.7631	-24.9484	-8.7631	-24.9484	
12/10/ 2018 12:59	12/10/ 2018 13:53	CTD	CTD034	35	120	-8.7631	-24.9484	-8.7631	-24.9484	
12/10/ 2018 13:05	12/10/ 2018 13:28	SODS FLOAT	SODS034	35	121	-8.7631	-24.9484	-8.7631	-24.9484	
12/10/ 2018 13:15	N/A	BALLOON	BALLOON 015	35	122	-8.7631	-24.9484	N/A	N/A	
13/10/ 2018 04:30	13/10/ 2018 04:58	BONGO NET	BONGO 018	36	123	-11.2623	-24.9374	-11.2619	-24.9387	
13/10/ 2018 04:33	13/10/ 2018 05:22	CTD	CTD035	36	124	-11.2624	-24.9374	-11.2616	-24.9400	

13/10/2018 04:33	13/10/2018 04:53	SODS FLOAT	SODS035	36	125	-11.2624	-24.9374	-11.2620	-24.9385	
13/10/2018 10:31	13/10/2018 13:40	CTD	CTD036	37	126	-12.0828	-24.9303	-12.0828	-24.9303	
13/10/2018 11:45	N/A	SKY PAN	SKY006	37	127	-12.0828	-24.9303	N/A	N/A	
13/10/2018 12:55	13/10/2018 13:32	OPTICS RIG	OPTICS 018	37	128	-12.0828	-24.9303	-12.0828	-24.9303	
13/10/2018 13:04	13/10/2018 13:29	SODS FLOAT	SODS036	37	129	-12.0828	-24.9303	-12.0828	-24.9303	
13/10/2018 13:19	N/A	BALLOON	BALLOON 016	37	130	-12.0828	-24.9303	N/A	N/A	
14/10/2018 04:30	14/10/2018 05:00	BONGO NET	BONGO 019	38	131	-14.7798	-24.9847	-14.7790	-24.9856	
14/10/2018 04:32	14/10/2018 04:56	SODS FLOAT	SODS037	38	132	-14.7798	-24.9847	-14.7792	-24.9855	
14/10/2018 04:33	14/10/2018 05:24	CTD	CTD037	38	133	-14.7798	-24.9848	-14.7783	-24.9868	
14/10/2018 08:57	N/A	ARGO FLOAT	ARGO001	39	134	-15.4078	-25.0008	N/A	N/A	Argo float No. 12691
14/10/2018	N/A	ARGO FLOAT	ARGO002	39	135	-15.4077	-25.0001	N/A	N/A	Argo float No. 7001

08:59										
14/10/2018 13:02	14/10/2018 13:39	OPTICS RIG	OPTICS 019	40	136	-16.0324	-25.0235	-16.0324	-25.0235	
14/10/2018 13:05	14/10/2018 13:55	CTD	CTD038	40	137	-16.0324	-25.0235	-16.0324	-25.0235	
14/10/2018 13:08	14/10/2018 13:33	SODS FLOAT	SODS038	40	138	-16.0324	-25.0235	-16.0324	-25.0235	
14/10/2018 13:10	N/A	BALLOON	BALLOON 017	40	139	-16.0324	-25.0235	N/A	N/A	
14/10/2018 13:59	N/A	SKY PAN	SKY007	40	140	-16.0324	-25.0235	N/A	N/A	
15/10/2018 04:33	15/10/2018 05:03	BONGO NET	BONGO 020	41	141	-18.3393	-25.0857	-18.3390	-25.0872	
15/10/2018 04:33	15/10/2018 05:25	CTD	CTD039	41	142	-18.3393	-25.0857	-18.3390	-25.0871	
15/10/2018 04:36	15/10/2018 05:00	SODS FLOAT	SODS039	41	143	-18.3393	-25.0857	-18.3391	-25.0871	
15/10/2018 07:10	15/10/2018 11:09	MOORING RECOVERY	MOORING RECOVER 001	42	144	-18.5506	-25.0874	-18.5354	-25.0919	
15/10/2018 14:25	15/10/2018 17:20	MOORING DEPLOYMENT	MOORING DEPLOY 001	42	145	-18.5785	-25.0864	-18.5443	-25.0799	

16/10/2018 04:36	16/10/2018 05:06	BONGO NET	BONGO 021	43	146	-20.3793	-25.0594	-20.3803	-25.0591	
16/10/2018 04:37	16/10/2018 05:23	CTD	CTD040	43	147	-20.3793	-25.0594	-20.3803	-25.0591	
16/10/2018 04:38	16/10/2018 05:00	SODS FLOAT	SODS040	43	148	-20.3794	-25.0594	-20.3802	-25.0592	
16/10/2018 05:35	N/A	ARGO FLOAT	ARGO003	43	149	-20.3792	-25.0598	N/A	N/A	University of Washington ARGO (AL) Float No. 12632
16/10/2018 12:58	16/10/2018 13:55	CTD	CTD041	44	150	-21.6038	-25.0464	-21.6037	-25.0465	
16/10/2018 12:59	16/10/2018 13:37	OPTICS RIG	OPTICS 020	44	151	-21.6037	-25.0465	-21.6037	-25.0464	
16/10/2018 13:03	16/10/2018 13:30	SODS FLOAT	SODS041	44	152	-21.6037	-25.0464	-21.6038	-25.0464	
16/10/2018 13:14	N/A	BALLOON	BALLOON 018	44	153	-21.6037	-25.0464	N/A	N/A	
17/10/2018 04:28	17/10/2018 04:56	BONGO NET	BONGO 022	45	154	-23.9995	-24.9993	-24.0000	-24.9999	
17/10/2018 04:28	17/10/2018 05:23	CTD	CTD042	45	155	-23.9995	-24.9993	-24.0000	-25.0000	
17/10/2018	17/10/2018	SODS FLOAT	SODS042	45	156	-23.9996	-24.9994	-24.0000	-24.9999	

04:30	04:54									
17/10/ 2018 12:56	17/10/ 2018 13:35	OPTICS RIG	OPTICS 021	46	157	-24.9059	-25.9033	-24.9059	-25.9033	
17/10/ 2018 12:59	17/10/ 2018 13:55	CTD	CTD043	46	158	-24.9059	-25.9033	-24.9059	-25.9033	
17/10/ 2018 13:05	17/10/ 2018 13:29	SODS FLOAT	SODS043	46	159	-24.9059	-25.9033	-24.9059	-25.9033	
17/10/ 2018 13:19	N/A	BALLOON	BALLOON 019	46	160	-24.9059	-25.9033	N/A	N/A	
17/10/ 2018 14:00	N/A	ARGO FLOAT	ARGO004	46	161	-24.9059	-25.9033	N/A	N/A	ARGO Float No. 12776
18/10/ 2018 04:34	18/10/ 2018 05:08	BONGO NET	BONGO 023	47	162	-26.6280	-27.6554	-26.6280	-27.6554	
18/10/ 2018 04:35	18/10/ 2018 05:00	SODS FLOAT	SODS044	47	163	-26.6280	-27.6554	-26.6280	-27.6554	
18/10/ 2018 04:40	18/10/ 2018 05:33	CTD	CTD044	47	164	-26.6280	-27.6554	-26.6280	-27.6554	
18/10/ 2018 05:40	N/A	ARGO FLOAT	ARGO005	47	165	-26.6279	-27.6550	N/A	N/A	
18/10/ 2018 10:36	18/10/ 2018 12:06	CTD	CTD045	48	166	-27.2001	-28.2502	-27.2000	-28.2501	
18/10/	18/10/	OPTICS RIG	OPTICS	48	167	-27.2000	-28.2501	-27.2000	-28.2501	

2018 11:00	2018 11:43		022							
18/10/ 2018 11:12	18/10/ 2018 11:32	SODS FLOAT	SODS045	48	168	-27.2000	-28.2501	-27.2000	-28.2501	
18/10/ 2018 11:26	N/A	BALLOON	BALLOON 020	48	169	-27.2000	-28.2501	N/A	N/A	
18/10/ 2018 12:21	N/A	ARGO FLOAT	ARGO006	48	170	-27.2001	-28.2501	N/A	N/A	SOCCOM float No.12696
18/10/ 2018 12:26	N/A	ARGO FLOAT	ARGO007	48	171	-27.2008	-28.2498	N/A	N/A	SOCCOM float No.12883
19/10/ 2018 04:30	19/10/ 2018 05:00	BONGO NET	BONGO 024	49	172	-29.1276	-30.2235	-29.1276	-30.2235	
19/10/ 2018 04:33	19/10/ 2018 04:54	SODS FLOAT	SODS046	49	173	-29.1276	-30.2235	-29.1276	-30.2235	
19/10/ 2018 04:34	19/10/ 2018 05:27	CTD	CTD046	49	174	-29.1276	-30.2235	-29.1276	-30.2235	
19/10/ 2018 12:56	19/10/ 2018 13:35	OPTICS RIG	OPTICS 023	50	175	-30.0059	-31.1497	-30.0059	-31.1497	
19/10/ 2018 13:00	19/10/ 2018 13:50	CTD	CTD047	50	176	-30.0059	-31.1497	-30.0059	-31.1497	
19/10/ 2018 13:05	19/10/ 2018 13:30	SODS FLOAT	SODS047	50	177	-30.0059	-31.1497	-30.0059	-31.1497	

19/10/2018 13:15	N/A	BALLOON	BALLOON 021	50	178	-30.0059	-31.1497	N/A	N/A	
19/10/2018 13:54	N/A	SKY PAN	SKY008	50	179	-30.0059	-31.1497	N/A	N/A	
20/10/2018 04:39	20/10/2018 05:06	BONGO NET	BONGO 025	51	180	-31.6171	-32.8809	-31.6168	-32.8855	
20/10/2018 04:40	20/10/2018 05:30	CTD	CTD048	51	181	-31.6185	-32.8841	-31.6135	-32.8881	
20/10/2018 04:45	20/10/2018 04:52	SODS FLOAT	SODS048	51	182	-31.6184	-32.8843	-31.6180	-32.8846	
20/10/2018 13:04	20/10/2018 14:41	CTD	CTD049	52	183	-32.3729	-33.6742	-32.3729	-33.6741	
20/10/2018 13:09	20/10/2018 13:58	OPTICS RIG	OPTICS 024	52	184	-32.3729	-33.6742	-32.3729	-33.6741	
20/10/2018 13:17	20/10/2018 13:45	SODS FLOAT	SODS049	52	185	-32.3729	-33.6741	-32.3729	-33.6742	
20/10/2018 14:10	N/A	BALLOON	BALLOON 022	52	186	-32.4331	-33.7360	N/A	N/A	
20/10/2018 15:08	N/A	ARGO FLOAT	ARGO008	52	187	-32.3770	-33.6752	N/A	N/A	SOCCOM Float No. 12881
21/10/2018	21/10/2018	CTD	CTD050	53	188	-33.8318	-35.2691	-33.8292	-35.2665	

04:36	05:35									
21/10/2018 04:40	21/10/2018 05:05	SODS FLOAT	SODS050	53	189	-33.8316	-35.2689	-33.8306	-35.2678	
21/10/2018 13:07	21/10/2018 14:37	CTD	CTD051	54	190	-34.5805	-36.0915	-34.5806	-36.0914	
21/10/2018 13:09	21/10/2018 14:05	OPTICS RIG	OPTICS 025	54	191	-34.5805	-36.0914	-34.5806	-36.0915	
21/10/2018 13:14	21/10/2018 13:37	SODS FLOAT	SODS051	54	192	-34.5805	-36.0915	-34.5806	-36.0914	
21/10/2018 13:27	N/A	BALLOON	BALLOON 023	54	193	-34.5806	-36.0914	N/A	N/A	
21/10/2018 14:45	N/A	ARGO FLOAT	ARGO009	54	194	-34.5813	-36.0915	N/A	N/A	Float No. 8064
21/10/2018 14:51	N/A	ARGO FLOAT	ARGO010	54	195	-34.5833	-36.0918	N/A	N/A	SOCCOM Float no. 12700
22/10/2018 04:29	22/10/2018 05:00	BONGO NET	BONGO 026	55	196	-36.1677	-37.8669	-36.1665	-37.8657	
22/10/2018 04:35	22/10/2018 04:56	SODS FLOAT	SODS052	55	197	-36.1676	-37.8668	-36.1667	-37.8659	
22/10/2018 04:40	22/10/2018 05:30	CTD	CTD052	55	198	-36.1674	-37.8666	-36.1652	-37.8646	
22/10/	22/10/	CTD	CTD053	56	199	-37.0121	-38.8346	-37.0121	-38.8346	

2018 13:10	2018 14:11									
22/10/ 2018 13:14	22/10/ 2018 13:54	OPTICS RIG	OPTICS 026	56	200	-37.0121	-38.8346	-37.0121	-38.8346	
22/10/ 2018 13:16	N/A	BALLOON	BALLOON 024	56	201	-37.0121	-38.8346	N/A	N/A	
22/10/ 2018 13:20	22/10/ 2018 13:45	SODS FLOAT	SODS053	56	202	-37.0121	-38.8346	-37.0121	-38.8346	
22/10/ 2018 14:25	N/A	ARGO FLOAT	ARGO011	56	203	-37.0120	-38.8349	N/A	N/A	
23/10/ 2018 04:28	23/10/ 2018 05:28	CTD	CTD054	57	204	-38.5841	-40.6551	-38.5838	-40.6533	
23/10/ 2018 04:42	23/10/ 2018 05:02	SODS FLOAT	SODS054	57	205	-38.5840	-40.6550	-38.5839	-40.6542	
23/10/ 2018 13:06	23/10/ 2018 14:41	CTD	CTD055	58	206	-39.2093	-41.4750	-39.2094	-41.4750	
23/10/ 2018 13:18	23/10/ 2018 13:35	SODS FLOAT	SODS055	58	207	-39.2093	-41.4750	-39.2291	-41.4954	
23/10/ 2018 13:39	N/A	BALLOON	BALLOON 025	58	208	-39.2094	-41.4749	N/A	N/A	
23/10/ 2018 14:56	N/A	ARGO FLOAT	ARGO012	58	209	-39.2100	-41.4750	N/A	N/A	

24/10/2018 04:36	24/10/2018 05:32	CTD	CTD056	59	210	-40.5210	-43.0831	-40.5184	-43.0805	
24/10/2018 04:44	24/10/2018 05:01	SODS FLOAT	SODS056	59	211	-40.5209	-43.0829	-40.5205	-43.0824	
24/10/2018 13:02	24/10/2018 14:45	CTD	CTD057	59	212	-41.3697	-44.0127	-41.3697	-44.0127	
24/10/2018 13:10	24/10/2018 14:00	OPTICS RIG	OPTICS 027	59	213	-41.3697	-44.0127	-41.4358	-44.0906	
24/10/2018 13:17	24/10/2018 13:40	SODS FLOAT	SODS057	59	214	-41.3697	-44.0127	-41.3697	-44.0127	
24/10/2018 13:20	N/A	BALLOON	BALLOON 026	59	215	-41.3697	-44.0127	N/A	N/A	
24/10/2018 14:52	N/A	ARGO FLOAT	ARGO013	59	216	-41.3704	-44.0136	N/A	N/A	SOCCOM float 12778
25/10/2018 05:34	25/10/2018 06:10	BONGO NET	BONGO 027	61	217	-43.0060	-45.9817	-43.0040	-45.9826	Ships time back 1 hour to GMT -1
25/10/2018 05:37	25/10/2018 06:33	CTD	CTD058	61	218	-43.0060	-45.9817	-43.0023	-45.9838	
25/10/2018 05:38	25/10/2018 06:01	SODS FLOAT	SODS058	61	219	-43.0059	-45.9817	-43.0045	-45.9822	
25/10/2018	25/10/2018	CTD	CTD059	62	220	-43.7905	-46.9552	-43.7905	-46.9552	

14:05	14:53									
25/10/ 2018 14:08	25/10/ 2018 14:47	OPTICS RIG	OPTICS 028	62	221	-43.7905	-46.9552	-43.7905	-46.9552	
25/10/ 2018 14:12	25/10/ 2018 14:35	SODS FLOAT	SODS059	62	222	-43.7905	-46.9552	-43.7905	-46.9552	
25/10/ 2018 14:24	N/A	BALLOON	BALLOON 027	63	223	-43.7905	-46.9552	N/A	N/A	
26/10/ 2018 05:31	26/10/ 2018 06:01	BONGO NET	BONGO 028	63	224	-45.2976	-48.8965	-45.2973	-48.8955	
26/10/ 2018 05:34	26/10/ 2018 05:58	SODS FLOAT	SODS060	63	225	-45.2976	-48.8965	-45.2973	-48.8957	
26/10/ 2018 05:35	26/10/ 2018 06:23	CTD	CTD060	63	226	-45.2976	-48.8965	-45.2971	-48.8947	
26/10/ 2018 14:07	26/10/ 2018 15:04	CTD	CTD061	64	227	-46.0176	-49.8723	-46.0175	-49.8723	
26/10/ 2018 14:10	26/10/ 2018 14:49	OPTICS RIG	OPTICS 029	64	228	-46.0176	-49.8723	-46.0175	-49.8723	
26/10/ 2018 14:15	26/10/ 2018 14:36	SODS FLOAT	SODS061	64	229	-46.0176	-49.8723	-46.0176	-49.8723	
26/10/ 2018 14:37	N/A	BALLOON	BALLOON 028	64	230	-46.0176	-49.8723	N/A	N/A	
27/10/	27/10/	BONGO	BONGO	65	231	-47.5618	-51.7740	-47.5656	-51.7741	Ships time back 1 hour to

2018 06:34	2018 07:02	NET	029							GMT -2
27/10/ 2018 06:35	27/10/ 2018 07:25	CTD	CTD062	65	232	-47.5618	-51.7740	-47.5691	-51.7723	
27/10/ 2018 06:37	27/10/ 2018 06:58	SODS FLOAT	SODS062	65	233	-47.5618	-51.7739	-47.5648	-51.7740	
27/10/ 2018 15:02	27/10/ 2018 15:50	CTD	CTD063	66	234	-48.1989	-52.6894	-48.1986	-52.6942	
27/10/ 2018 15:06	27/10/ 2018 15:44	OPTICS RIG	OPTICS 030	66	235	-48.1989	-52.6894	-48.1986	-52.6932	
27/10/ 2018 15:10	27/10/ 2018 15:38	SODS FLOAT	SODS063	66	236	-48.1989	-52.6893	-48.1987	-52.6922	
27/10/ 2018 15:42	N/A	SKY PAN	SKY009	66	237	-48.1987	-52.6928	N/A	N/A	

Appendix 3: Chief Scientist's Notes

20 September – Travel to Harwich

Depart PML 0645. 2 vehicles. Vehicle 1 – Me Bob, Andreia Tracana, Afonso Ferreira; vehicle 2 – Becca, Malcolm, Giorgio, Wade De Kock. Also met up with Natalia Llopis Monferrer and Aude Leynaert from UBO in the PML car park. Natalia and Aude followed my vehicle. They had a Renault Kangoo. Travelled A38, M5, M5, M25, off at J28 onto A12 at Brentwood, A120.

Arrived 1345.

No containers onboard because port cranes won't operate above 25 knots. No chems onboard either.

Only gear loaded by end of day – UBO and UEA.

Organised for PML container to be brought alongside on 21st and unstuffed on dockside. Use ship's crane to load gear onto ship.

Evening – Train into Harwich Town. There's a train in the dock because of Harwich International ferry terminal. 2 stops, 4-5 mins into town.

21 September

Alyse, Jenna and Ian Murdoch arrived

Fran Pitt dropped off gear.

There was an electrical blackout at approx. 0745. Power restored at 0810.

Today – Meeting of BAS, NMFOps and Harwich Port to discuss future of using Harwich as the mob port for the SDA.

Unloaded Orchestra/Andrex II boxes from the PML container (on the dockside) to the explosives locker. Operation ended 0950. Decision was then made to bring the PML container onboard and unstuff. To achieve this, needed to raise gangway to allow the port's massive crane on rails to do the job. In addition to the PML container, the 2 RN containers were also loaded. Finished around 1130. PML container unloading then commenced unstuffing. Stopped for lunch at 1200 and then finished unloading between 1230 – 1300.

Informed by the captain – shipside still had a lot to load on 22nd. Would have to work an 0800 – 2000 shift. Hoped to leave Harwich at 1000 on 23rd.

Mid-afternoon –Discovered the new 20L Niskin bottles were not ready to use i.e. no lanyards/snap hooks.

Also, issues with 2 PSTs: 1 simply not here, 1 is a photocopy. Captain looking into the source of photocopy as the scientist has said that is all they were issued with by the company. Missing PST – FedEx original from the USA to arrive in Portsmouth on Monday where we will pick up bunkers and AVCAT fuel.

22 September, Saturday

Up at 0550 – Emptied cabin boxes. UIC – rapidly emptied boxes and stowed gear before anyone else around. Got fixing bits for FCMs, MIII and fridge ready for Becca and Wade to deal with. When they arrived, they were helped by Afonso. I taught them how to fix things down.

During the course of the day – finished FCMs, MIII and fridge. Turned B0264 transformer on (Wade's).

Routed pH system waste line from pH system , along bench to kneehole under the Autosal for Andreia, plus, provided a waste drum.

Set up Arwen with peristaltic pump, adjusted tubing etc. so Sterivex would be in sink. Too short to begin with. If the Sterivex had come off the tube it would have flooded the bench.

Helped Afonso secure dust collector on monkey island.

Put waste containers in the hold for easier access. Hold basically empty in comparison to previous years.

Sorted out locations for gas cylinders (AMT and Andrex 2). Charel's - outside the UIC in the gallery. 2 large and 1 smaller.

3 x CO2 standards, Ian's, Boat deck, stbd side.

5 x helium cylinders on Bridge deck for weather balloons

Sorted container for empty boxes and accessible gear, particularly Hans and Millie.

Made sure Alyse and Jenna OK. Alyse gave me UCI Anteater college team insulated mug and socks.

All JR18001 chems are OK, except John Ballard's box with a Class, 5, 6 and 8; all tiny amounts – Were air freighted, so OK for IATA?

Things to do before sailing:

Tidy last few things in lab

Print AFC log sheets

Cruise intro presentation – scientists, AME, IT, lab manager – Time - Sunday 1600?

- Discuss water budget, especially predawn, Underway – on all the time to minimise flow fluctuations, Issues so far?, changes to scientists' original science plans, meal times at sea – same as in port (0730, 1200, 1800)

Cruise intro presentation - crew

See Aisling – lab induction – format and time.

115V supply from main lab – circuits tripped

Check water budgets

23 September – cruise departure

0900 – safety briefing. Scientists = SPP = special purpose personnel, hours of rest, cabin/lab inspections – Sunday mornings.

NOTE – NO VSAT communication – everything has been checked, so hope all will work when we leave Harwich. Other ships have experienced the same problem.

Went through donning of immersion suits. Several people put them on.

Cruise photos – put on shared drive

1300 – Muster and drill

1330 – Lab management intro

1700 – Science meeting

Ask for chairs to be moved out of UIC.

HORRIBLE weather – cast off 1042

Note –luggage locker for large cases – f's'cstle deck opposite to saloon entrance

1340 – Lab induction presentation in the bar.

Accidents and near misses – no blame culture. Labelling for chem lockers and in labs

Aisling proposed using a colour coding system. I proposed using the GHS symbols – I have a set of stickers.

Lone working e.g. Natalia – set up plan with the PSO

Haz waste – Aisling proposed a consignment workshop to train people.

Waste – into UN-approved containers

Lab coats – to be worn at all times, regardless of temperature. Includes officers on their rounds. Temperature will be monitored.

Had to sign documents saying we'd read our own H and S documentation.

Went and saw ETO re. Alyse's power issue. Her voltage regulator was tripping the 240V circuit.

He told me that the 115V circuit breakers had a message on them saying, "Do not use". Doug went away and found the chief engineer who said that the message tags had probably been left on after refit because they were not being used. The ETO then turned on the circuits and tested them with an AVO meter – All OK. Ran an extension lead from the main lab., through a gland and around the trunking in the wet lab to the kit on the bench under the window.

Science meeting 1700.

Igor – zooplankton metabolism. On A28 will be focussing on bacterial respiration/production + DOM.

BAS IT. David Hunter – first cruise. Sean Vincent – second cruise.

Alyse and Jenna – bacteria metagenomics

John Ballard – Question – When to do nutrient measurements? He will combine 2 CTDs into a single run. Natalia wants nitrate results 2-3h after CTD. Therefore run samples after predawn CTD.

Arwen – told everyone about data processing from CTD and underway.

People using the underway

Alyse/Jenna, HPLC, salinity, Giorgio and Bob.

Work/shared drive for the cruise – Legwork and Legdata. Also a media drive.

Note: Main anemometer doesn't work at the moment. Fred has one installed and Tom/Ming (PML, not onboard) have one installed for underway atmospheric sampling.

The NavMET system – http://www – JCR homepage, select NavMET near bottom of page.

Water requirements

Andreia – 125 m – go to 150 m. surface essential. 5 depths total predawn and noon – surface, base of ML where chl just increasing, DCM, mid-way along lower side of chl peak, just below chl peak.

Alyse – spread of 5 depths. Select from surface, 20, 50, DCM, DCM+10, 150 predawn and noon

Fran – the dregs in the NAG above 50 m. Noon CTD OK, therefore can have whole bottles.

UEA – predawn only, approx. ½ volume available on the CTD rosette.O2 and DOM – different bottles.

DNA/Sterivex – predawn and noon.

NOTE: Find light table

Arrange meeting with bridge team

Passage – ETA Tuesday noon and Wed 0430 – Territorial waters issue? – No

When first clock change?

Frequency of drills?

Make sure FCMs running

Chat with Carol about taking on the predawn CTD so I can train Igor/Natalia to use the bongo net.

Plan for officers and crew.

Water table for Tuesday

Put GHS stickers up in the UIC

Rejig water budget. Check last year's first couple of casts to gauge water column depth.

Hours of rest – Purser placing current month on shared drive?

Distribute science plans to crew

Construct bongo net

Distribute PML mugs to crew

24 September – Portsmouth – Sunny

Informed original PST had arrived at purser's house so scientist was fine to sail.

Photocopy PST – Captain satisified it is genuine. Scientist fine to sail.

Natalia – lab chair.

Alyse and Jenna – not enough 1mL tips for original science plans. Have obtained some tips from Natalia but have decided to scale back operations on the CTD to 2 depths – surface and 50 m at predawn and noon stations.

AVCAT/bunkers – Barge (Teesdale) only operating at 100 cubes per hour. Hopefully finish 1830 and sail 1930.

Distributed science skeleton and initial science schedule to bridge, Mackem (Cliff) and crew bar.

Concentrating cruise info in the UIC on the side of the server cabinet.

Set Cecilia up with reverse filtration gear and gave her a lesson.

Found Lugol's dispenser in one of Wade's drawers

We left Portsmouth this evening about 19:20 and hope to have our first station tomorrow around 13:00.

25 September. Sunny and calm

To Do:

Check with Sean – CTD bottles ready?

Confirm time for CTD and distribute.

Crew presentation – Check time and place with Cliff

Make net – 1 x 200 µm, 1 x 120 µm. Igor, glue 63 µm mesh in one cod end.

Wrap birthday present, distribute 5 x cards (inc. group cards)

Hours of rest – check with purser

Bob's Temperature float (SOFD, SOD) – RA to captain and 1st officer.

Optics rig and sun position relative to ship at noon station

Silvia Pardo – EO email.

2nd bit of tubing for Cecilia

See purser –birthday cake

Deck incubators – See Rob (DeckEng)

Overside equipment deployment meeting, aft deck 1100

Build incubators

0730 – Directly south of Newton Ferrers. ETA at E1 0845

Wet lab, left sink – Possible to get a piece of matting in the bottom to stop empty plastic bottles from floating around? Possible to shorten tubing on underway outlet to between 5 and 10"? – Yes

Funnel – Arwen, for salinometer waste collection.

Crew presentation 1430 – Bar

Purser– list of bond items

After lunch – load test CTD wire.

1300 - Test CTD. 10 depths. 5, 8, 12, 17, 22, 30, 50, 60, 70, 80. 12 m = DCM. Water column 87 m

Everyone treated it as a guaranteed serious CTD. Water was tight.

Bottles 7 and 19 – bottoms not closed because too close to the central frame. Bottles 14 and 23 leaked. 8 was a misfire.

Also deployed the optics rig to check the convoluted route around the RN container – All OK

Also deployed the temperature float (SOD).

Alyse/Jenna working pattern – Alyse 1500 – 1800 and 0300 – 1200, Jenna 1200-1500 and 1800-0300.

Discussed Natalia's lone working in container. Approx 0500 – 1600. Doing microscopy so will need regular breaks. Plenty of other people around during the day. Also said I would look in on her.

26 September

Deck incubators – Set up with Ian and Rob

Noon CTD sheet

Laptop – to CTD

Notice – location of CTD data on shared drive – Legwork/data_management

Talked with captain. He reckoned current ETA in Falklands – 0500 30 October. Also told me location of weather info. Media drive/jcr/0weather/PassageWeather

Hours of rest notice – location on shared drive

Logs – Bongo, Progress

Fred – no weather balloon today. Gavin had underestimated the number of balloons he thought he'd packed. Not enough for every day. Only 28 instead of 40. Fred had found a couple in the BAS balloon box but still not quite enough.

Check event log for time on station

Issue with prop motors – don't know what is causing them to stop. Assessing.

Post 6x science schedules. Bridge, bar, Mackem, UIC, Main/wet lab door, duty mess door

CTD03 – Sunny, choppy. DCM 25-46 m, DCM1 – 30 m. 02 max 0-25 m, surf. Flor 0.39, salinity 35.59, ML 49 m.

Predawn net - trained Igor and Natalia in the ways of the AMT bongo deployments. Igor's done plenty before, so that's good. We were only in 148 m of water, so I wouldn't normally have done a net. Now I know why. Full of salps. I've used 3 sample pots already. Things are beginning to slot into place now as the number of 'start of cruise' tasks diminishes. Got the deck incubators up and running this morning with Ian Murdoch and the deck eng., Rob.

Email to Andy Rees, PML - Graham's (Captain) current calculation for getting to Stanley (minus SAG mooring turnaround) at 10 knots and 4 h sampling per day is 05:00 on 30 October. If we keep shaving off the odd hour here and there, we should be OK to do the deeper casts when we deploy the SOCCOM floats. Lunchtime CTD was a breeze. People only need just over 100 L of water. Looks like I'll be growing a beard. I've definitely forgotten my razor's charge lead. Doh. There will be more hair on my chin than on the top of my head by the end.

Carol's in charge again tomorrow at the predawn whilst I let Igor and Natalia show me how they do the net.

CTD bottles - a couple won't close as they catch on the frame. Turns out the new bottles are slightly different in that their mounting apparatus is slightly higher up on the bottle, meaning that the bottle sits lower on the frame. We are using the BAS frame, which has been properly straightened and has had about 2.5 inches added to its height. Ian Murdoch reckons the NMF frame will have the same problem. Our current solution is to add an additional plastic ring, which holds up the central carousel and bottle mounting ring to increase the height of everything so it should clear the frame. The extra ring is part of the spares inventory. If this works, we won't have to use 2 x 12 L bottles on the rosette, which is a pain for the predawn cast. Email end.

Plan for 27th – After predawn CTD Sean and Ian will take all bottles off the CTD. At 0800 the ship will stop. The central section of the CTD will be unbolted and the and the 10T crane will lift the central section out. An additional/spare white plastic ring will be placed on top of the existing plastic ring which separates the carousel/bottle holding apparatus from the rest of the frame and the CTD put back together again. This will enable the Niskin bottles to sit higher on the frame and hopefully stop the bottoms of bottles 7 and 19 from getting fouled on the frame.

27 September

Cloudy here today. Here being 45 degs 23 N, 13 degs 16 W.

Carol running predawn CTD – Print off light table.

2 birthdays. Alyse is 30, David Hunter (BAS IT) is 25.

Start Bongo log, CTD log/summary, Progress log.

Check event log board.

Make a waste log – Aisling

CTD – Noted bottles 4 and 5 leak once the vent is opened. Question – Rubber connecting end caps a bit slack? Mentioned to Sean

Predawn CTD future – Have passed the predawn CTD baton to Carol. I will do the net with Igor

John – wants 10L from 500m at noon CTD for nuts.

0815 – Added ring to CTD. Bottles raised by 10-12 mm. Lower end caps of bottles 7 and 19 are now clear of the angled part of the frame.

Underway system – started 0800 25/9/18. Giorgio's underway system started approx. 2100 25/9/18. Wasn't on before this due to issues with wires/cables/non-connectivity. Miscommunication between different people in the optics group as to what was required.

Rob has a log of underway system events and can provide at the end of the cruise.

Radiometry (Bob) – HyperSAS running since Harwich.

Noon CTD (005) – At same latitude as Bordeaux

Note: Adding the white plastic ring to the CTD worked.

Email to Andy Rees, PML - Today is a double birthday. Alyse from Unversity of California, Irvine turns 30 and David Hunter, BAS IT is 25. Massive sponge cakes covered in cream at dinner. Very tasty.

The ship's underway was switched on the morning after we left Portsmouth. To be precise; 0800 (BST) on Tuesday 25 September.

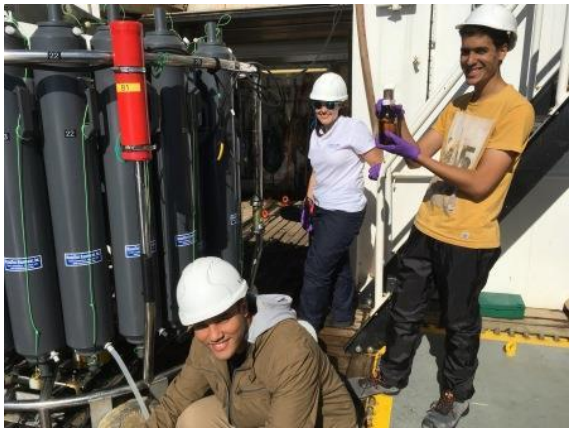
Bob's HyperSAS has been running since Harwich

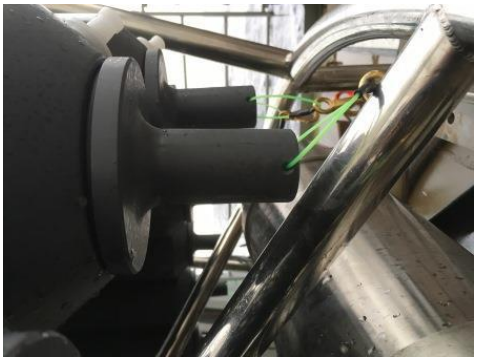
Giorgio's underway has been running since about 2100 (BST) on 25 September. There were various cabling issues that needed sorting

Aisling will be Fred's balloon launching buddy and she was at the CTD yesterday with Alyse/Jenna's bottles.

Have hopefully sorted the problem with 2 bottles getting fouled on the CTD frame and not closing at the bottom. All the bottles were taken off, the middle of the CTD raised with the CTD gantry and an additional plastic ring inserted to increase the height of the carousel and bottle mounting ring by 10-12 mm. The bottles are now clear of the angled bit of the frame that runs from the centre out to the frame edge.

Just a few random shots. There's a shot of Wade at the CTD, one of Wade, Andreia and Afonso. One of Alyse sampling at the CTD today on her birthday. Then there are a couple of pics relating to raising the centre of the CTD frame to add an extra white plastic ring under the bottle attachment ring to raise the bottles up by 10-12 mm, so the bottles don't get fouled on the frame - This was done after breakfast and tested at the noon CTD - It worked





Email end

28 September - Cloudy

Hours of rest notice tomorrow

Salinometer – Potential issue. Arwen has done a couple of samples and thinks the results aren't right. She will run some standard seawater and check. If there is a problem there is a spare salinometer in the hold.

Noon CTD – At the same latitude as the northern Portugal/Spain border.

John – using this CTD as a dark cast for his FLBB (florescence and backscatter meter). I.e. the sensor window has a piece of insulation tape stuck over it.

I was asked by the captain when to retard the clocks. I checked my old notebook from last year. We retarded the clocks when we left the Azores. Do the same this year.

At 1800 the captain came to see me with a faxed document in Portuguese. Turned out to be DipClear for Portuguese waters. Afonso translated it with me and the captain got someone at BAS to do the same. For now the captain just needs to file our noon position each day with 2 Portuguese authorities. Need to send cruise report and data link (BODC) within 6 months

Want photos of all the crew.

Email to Andy Rees, PML - Cloudy here. Currently at approx. 42.5 N, 15.5 W. Doing just over 10 knots.6 CTDs under our belts now. This morning's was the first with no misfires. The bottles are hopefully bedding in. Carol is happy to continue running the predawn CTD, so I'm netting with Igor.

Bob's 'child's toy' is entered into the event log as the SOD; surface oceanographic device. Bob's original name for it was surface floating oceanographic device, but the F seems to have got dropped off.

Having issues with the PCO2 system but Aisling is in contact with Ian. I took a look last night but couldn't see anything. I suggested she took pictures and sent them to Ian, which she did. Currently one alarm won't go away - Water in reservoir. Ian is aware.

Noon CTD – At the same latitude as the border between northern Portugal and Spain.

Early evening – Informed by the captain that we have received diplomatic clearance for working in Portuguese waters as we transit between the Azores and Madeira.

29 September – Cloudy (Saturday)

Clocks back 1 hour tonight

Hours of rest notice

Inspection notice for tomorrow. Labs/cabins

Photo of event log board

Crew photos –Carol will do.

Email from Carol – Possible to have O rings handy near the CTD? She had pushed a Niskin tap all the way in. I showed her what had happened and how to prevent it happening in future i.e be careful when putting tubing on the tap so that it doesn't cover the O ring. If this happens, the O ring is pulled off and the tap will then become unseated.

She also enquired if it was possible to open the outside door from the wet lab as Chata had been unable to open it. I showed them how to open it.

Emailed Vas – pH system issues. See email to Andy below.

Notice -20 ^{o}C chems

Print cabin list

Carol – requested 0400 call if she wasn't already up

Noon CTD – At least 12 bottles started leaking from the bottom cap once the vent had been opened. Asked Sean to tighten the rubber tubing attached to the caps.

Email to Andy Rees, PML All well. 8 CTDs, 4 nets, 4 optics rigs, 2 weather balloons and 8 temperature float/child's toy/SOD deployments under our belts now. Currently taking about 3 hours a day to go from full speed to stationary, to doing stations and then back to full speed, so I'm looking at doing a deep CTD to 4000 metres in the NAG in about 5 day's time for the Claire Evans group. Should take about 3 hours, all being well.

Had a couple of issues with the new pH system. One was Blue Tac related (The flow cell was fixed in place with Blue Tac and had worked loose. Added some new.), the other was fixed with blue tac (circlip holding the main lamp in place had disengaged and was not doing a good job so the lamp was firmly stuck in place with a generous amount of Blue Tac)

30 September

We are now on GMT. The clocks were retarded one hour last night. I don't think anyone was caught out by it, which may be a first.

NavMet system – Very unreliable. Keeps freezing.

Deep CTD for DOM – Hans/Millie. Ideal position would be 30^{o}N, 25^{o}W. Ask Dom (2nd Mate) for updated ETA at WP17 – 26^{o} 46' N, 25^{o} 15' W AND check depth. Checked AMT23 stations as the track was similar and all stations between 31.3N, 22.67 W and 24.22 N, 26.26 W were >5000 m.

Painting notice

Note – Underway system in UIC, chlorophyll is reading 4 µg L^{-1}. Pattern looks OK. Calibration issue? Check with Sean.

Arwen is now happy that the salinometer is working properly

01 October (Monday) Raining, lightning during the night

Natalia – note about sampling requirements

David – Note about Navmet system resetting – He will be getting it to reset automatically every hour, 5 minutes before the hour so it will be less likely to freeze.

Crossing the Line list

Ian – sending email to Paul Provost re. the fact that the max depth we can reach with the CTD wire is 4200 m – Is this deep enough to test the acoustic releases for the mooring?

Ian – problem with Hans/Millie's RN container's air-con. Keeps on tripping as soon as it starts because it is too hot.

Email Fran – Storage of full carboys in wet lab, rather than cool spec room, transport of carboys back to UK.

Email to Andy Rees, PML. Still cloudy here. Plenty of lightning and rain last night. Showery this morning. Planning to do 4000m CTD Tuesday morning at 1045. 12 CTDs, 12 SODs, 6 Bongos, 4 weather balloons and 6 optics rigs so far. All going well. We've now had 2 Beer O'clocks at 1730 on the starboard side between the CTD and the winch cab. Cloudy but over 20 C, so pleasant. Having forgotten my razor charger, I'm now sporting the beginnings of my fourth ever beard.

Just finished the list for crossing the line and there are 16 scientists and techs who haven't crossed the equator before. Let the planning for the fun commence.

Giorgio came to see me about the possibility of recovering 1-2 floats with non-working sensors, originally deployed on AMT24, which are currently very close to our track. If we can make it, it will be in about a week's time. Not sure best way to recover it/them. Rescue boat? Email end

02 October – Clear, sunny, sea - glassy

Transmittance and chl on underway plugged in the wrong way round since cruise beginning. OK now. Told Arwen

Georgina asked if it would be OK to make CTD wire thickness measurements at bottle firing depths during the deep CTD – Fine.

Had a chat with Ian. Air-con in RN container is fixed. Paul Provost says 4200 m to test the acoustic release is fine.

Noon station, deep CTD to 4000 m – Fred is going to launch a tethered weather balloon to approx.. 100m with a camera on, take pics, bring back down and then launch the balloon as normal, with a radiosonde on it. captain said OK as windspeed at only 1 knot.

Swimming pool put up on aft deck.

Late afternoon – recovered life ring from MV Sana of Valetta (crude oil tanker). Later found out the ship was operating off the east coast of the USA, so life ring must have just have been lost.

Email to Andy Rees, PML. Begins with: Email from BAS: - received before breakfast.

Morning Graham and Glen,

I would like to enquire of you both if it would be possible to get in a day earlier than currently planned? If you ran at higher speeds between stations Graham would this be possible? and Glen would you still be able to accomplish your science objectives?

We need to have a bit more time for the DASH to get the cargo from the JCR to Rothera.

Best Randy

I'm pretty relaxed about it. The increased speed, particularly as the request has come relatively early, isn't too bad.

We hit the jackpot today. 1045 CTD to 4000 m. On deck 40 minutes ago. Our first truly glorious day. Sun, glassy deep blue ocean, wind speed 1-2 knots. Fred said the steel on the deck on the monkey island was up to 60 C. CTD went well (2 h 50 mins) and now we are trundling along at just below 11 knots. The increase in speed might mean a couple fewer stations, but if we are still able to work until the 27th, that's still another 50 stations and we've racked up 15 already, so we will still be fine in terms of total stations. Yes, I know, don't count your chickens, but at the moment we are still in a healthy position. Fred launched a weather balloon at the noon station with a 100 m tether and a video camera attached to it to take aerial footage above the ship. Lots of spinning footage but Fred hopes to get some reasonable still shots of the ship.

We now have a pool in the aft deck, 8 feet diameter. Big enough for 7-8 people to cool down when the sun’s beating down.

Late afternoon. A life ring from the MV Sana of Valetta was recovered from the sea. It later turned out the vessel was operating happily off the coast of the USA, so the life ring must have been accidentally lost overboard. Email ends

3 October

Talked to Bob about the underway system's chl and transmittance being plugged in the wrong way round until 1920 on 1/10/18. He said he and Giorgio had an underway system that measured absorbance at 656 nm and compared it to zero (filtered seawater) at <1 minute intervals (binned to 1 min intervals) that provided [chl] estimates to within 10% of HPLC. Could actually be more accurate because there was no sample manipulation.

MOB drill for crew at 1030. Ship slowed and turned. MOB boat was deployed. Drill ended approx. 1115.

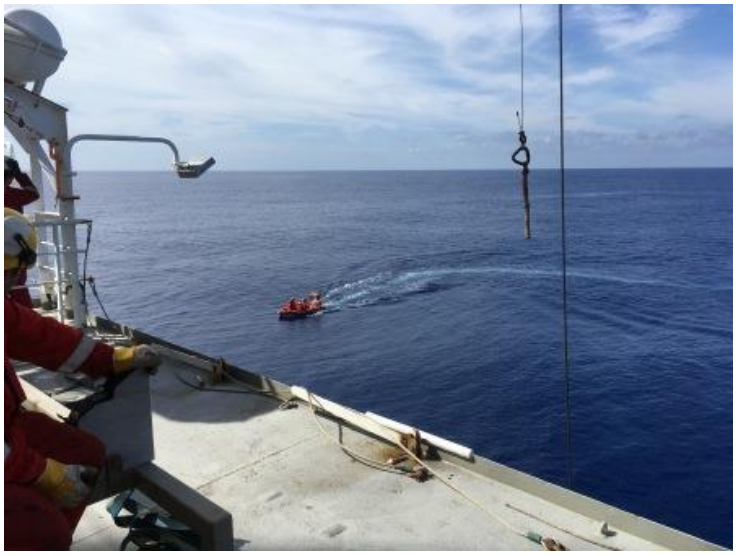
Approx. 1200 – Oil spill on aft deck, starboard quarter. Bio oil in the airgun boom leaked on the deck (4-5 L) during routine maintenance. Deck hosed down and oil tank refilled.

Metering block for the optics rig Kevlar rope not working. Probably batteries out of power (12V). Sean investigating.

Chata came to see me to let me know the CT lab temperature had increased from 4 to 9^{o}C. Checked shortly afterwards and temperature was back at 4^{o}C. It had probably been on a defrost cycle. Chata said she had heard a noise like falling ice.

Email to Andy Rees, PML. This morning was absolutely flat calm and starry – NO wind.

Mid-morning, the crew performed a man overboard drill. This involved slowing and turning the ship through 180 degrees and then launching the rescue boat. Pic attached.



First flying fish sighted this afternoon.

Evening BBQ to celebrate Tom the steward's birthday on the after deck Email ends

4 October – Starry, a few clouds

First predawn CTD with squid and flying fish. Flying fish also seen yesterday.

0800 – More clouds, still plenty of blue sky.

Air-con in Hans/Millie's container not working. Turned off last night during the BBQ due to smoke. Air temperature hot this morning. Air-con kept tripping out as soon as it was started. Went and got the portable air-con unit from the gym to try and cool the anteroom with the air-con unit in it. Also went

and got both of my fans to create better circulation AND a large bucket of ice to lower air flowing onto air-con unit. Once temperature went below 26^{o}C the unit started and kept going. For the future – Keep the air-con on all the time. If/when there is another BBQ Hans/Millie will either organise work so they are not in the container or the BBQ will move to the f'c'stle.

Recovery of one of Giorgio's floats looking promising. It is only 40-50 miles off our intended track. The second float is over 350 miles off-track, so we will focus just on the nearest one. Cliff, the science bosun, says there is a cradle on board for recovering gliders, which would be ideal. Current ETA at the last known position of the float, 18:00 on 7 October.

5 October – Starry, a few clouds

Natalia has asked for both microscopes to be moved out of the RN container due to vibration issues. Have agreed with Sean Vincent to move Natalia's microscopes from her RN container up to the computer room, just in on the left.

After predawn station – noticed we were only doing 1.5 – 2 knots. Moving at 12 knots again by 0645. The captain came to see me at 0800. Definitely prop motor issues. Ship stationary a couple of times. Might have to make a decision about going into Cabo Verde.

Had a chat with the 1st officer re. chems. Still outstanding issues. Not just with our cruise but subsequent cruises too. One problem is that she is not working with the final version of the PML manifest. Another problem is that she has simply been overloaded. She is only about half way through the complete DG manifest for the ship.

John – Says there is a potential issue with bottle 4 – It's had lower nutrients than expected at several stations (compared to bottles either side), especially PO4 and NO3. Will fire bottles 4 and 5 at the same depth at the noon CTD. Let Sean know.

Alyse said she and Jenna had finished sampling for Fran.

Note: Alyse and Jenna filter approx. ½ a tonne of water a day.

6 October

Phosphorescence, squid and flying fish at the net station near the bow of the ship.

Prop motor issues a couple of times during the morning. Approx 1040, prop motors cut out. All was reset and we were underway again after about 10 mins. The captain told me that, yesterday they could only manage 800 kW of power, which is not enough, particularly if there is any heavy weather. They are still waiting for a response from the manufacturers about the main fault encountered. Seriously considering options wrt pulling into Cabo Verde. Motors cut out again at 1120

7 October

Prop motors a major issue during the night. Stationary for approx. 1.5 hours. Engineers and ETO working hard on the problem. Talked with captain about possible float recovery. On the edge of feasibility. ETA currently 19:30-19:45 today.

Noon station time reduced to 40 mins, ship speed all afternoon 13.5 knots. Got to float site approx. 19:20; float sighted approx. 19:30; float recoverd at dusk. See 8 October entry sent to Andy Rees for a summary of the weekend and details of the float recovery.

Aisling came and found me and asked if I would be happy for her to contact BAS Cambridge to ask if the lab coat policy could be relaxed because of the high temperatures in the labs.

08 October – Monday Stars and clouds predawn. 0915 onwards, rain

Should arrive Falklands 3 weeks today

Steaming at 10 knots. Much cooler with clouds and rain. Noon station – Raining hard.

NOC group RN container leaking through the main door……..again, now it's raining. Ian showed me a video of water coming in through the door seal. Solution – needs some kind of gutter above the door

Email to Andy Rees, PML.

It's been an interesting weekend out on the briney.

Saturday and into Sunday morning we had serious issues with prop motors failing. When this happened the ship would basically come to a standstill. I think the worst period was early Sunday morning before the station. The ship was stationary for about 1.5 hours whilst the engineers did everything they could to remedy the situation. There were serious considerations about whether we could safely continue or whether we would have to call in to Cabo Verde to resolve the issue as it was the closest and last port of call before venturing out into the south Atlantic. I am pleased to say that, for the moment at any rate, we are continuing on our way and we have now had no obvious problem for 24 h.

The great success of the weekend has been the recovery of a BGC float deployed by Giorgio on AMT 24, on 10 October 2014. Giorgio had been to see me a few days before to tell me there were 2 floats really close to our intended track that had failed sensors on them, which had been measuring backscatter, fluorescence and irradiance. So, the question was, could we recover one/both of them? One of them was several 100 miles off our track so that was unlikely, but the other was probably only 40-50 miles off track, slightly to the east of our planned track. I had a chat with the captain, he did the sums in terms of time available and likely time of arrival in the vicinity of the float (estimated at about 18:00 on the 7th Oct) and decided that it was worth a try. That was before the latest issues with the prop motors (ongoing for over a week), which ate into the ETA. We got the predawn station done yesterday morning, redid the timings and it was really touch and go as the ETA was between 1930 and 1945, with sundown being 1935. I decided to shorten the noon CTD station. We only went to 300 m with the CTD, only sampled 10 depths and only fired 16 bottles, meaning the CTD only took 36 mins. How many onlys? The optics rig took about the same time. That tipped the balance, as far as the captain was concerned and we steamed at 13 knots towards the float with an ETA of 1915 - 1930.

The float had been ordered to go into "End of Life" mode, whereby it comes to the surface and periodically sends out its position AND says "Help". During the afternoon it sent its position every hour, which was received by Giorgio via email. At 1640 the frequency of position updates was increased to every 10 mins. The float had been travelling SSE with the equatorial counter current at up to 0.8 knots but as we got closer it started swinging west. After dinner I found Giorgio up on the bridge with his laptop, relaying the floats position to the captain. An added complication was a container ship travelling SE which looked like it might be on a collision course with the float but eventually passed to the south of it. There were teams of people looking out on the bow and on the bridge and a further recovery team on the starboard side with a glider recovery cradle with long strops attached to the 10T crane and a long pole with wire lasso. The float was actually sighted at approx. 1930, which was no mean feat, given that very little of it was above the surface. We were really lucky with the sea state. The captain manoeuvred the ship so the float came down the starboard side about 20 feet from the ship's side. We couldn't quite get it with the cradle but we were able to lasso it, tighten the noose and then guide the float into the cradle. It was then craned on board and removed

from the cradle to a loud round of applause. The float looked in excellent shape but was definitely covered in a slimy biofilm. Giorgio took swabs from the main body and sensor windows, put them into vials and then added RNA-later for genetic analysis back at UCI. The only visible issue with the float was that one of the stainless steel rods connecting the buoyancy foam and the deployment ring had disintegrated. Another thing that Giorgio discovered was that, when he touched the antenna with his thumb and forefinger it unscrewed easily, so may already have been loose. I have included a picture of Giorgio beaming happily after being reunited with the float after 4 years (minus 3 days).

A great success and a massive team effort. A heartfelt thank you to all concerned. A really slick operation. Float revocery position: 8.8701^{o} N, 26.9639^{o} W at 19:54 GMT.

Top left: Float as seen from the ship

Top right: Giorgio Dall'Olmo, reunited with the float

Left: *Sargassum* weed (upper item) and and a pyrosome (white 'finger')

Overnight we have been travelling at a more sedate 10 knots. We are into *Sargassum* and Pyrosome territory now. We started seeing lots of *Sargassum* yesterday afternoon and there was masses of Trichodesmium in the nets yesterday morning. I have included a picture of a pyrosome from this morning's net and some Sargassum that got caught on the net's winch wire. The pyrosome was about 12 x 2.5 cm in size.

Raining hard at lunchtime. Much cooler (3 ^{o}C lower than previous days).

9 October – Starry, no clouds, sunny day

Crossing the Line Day

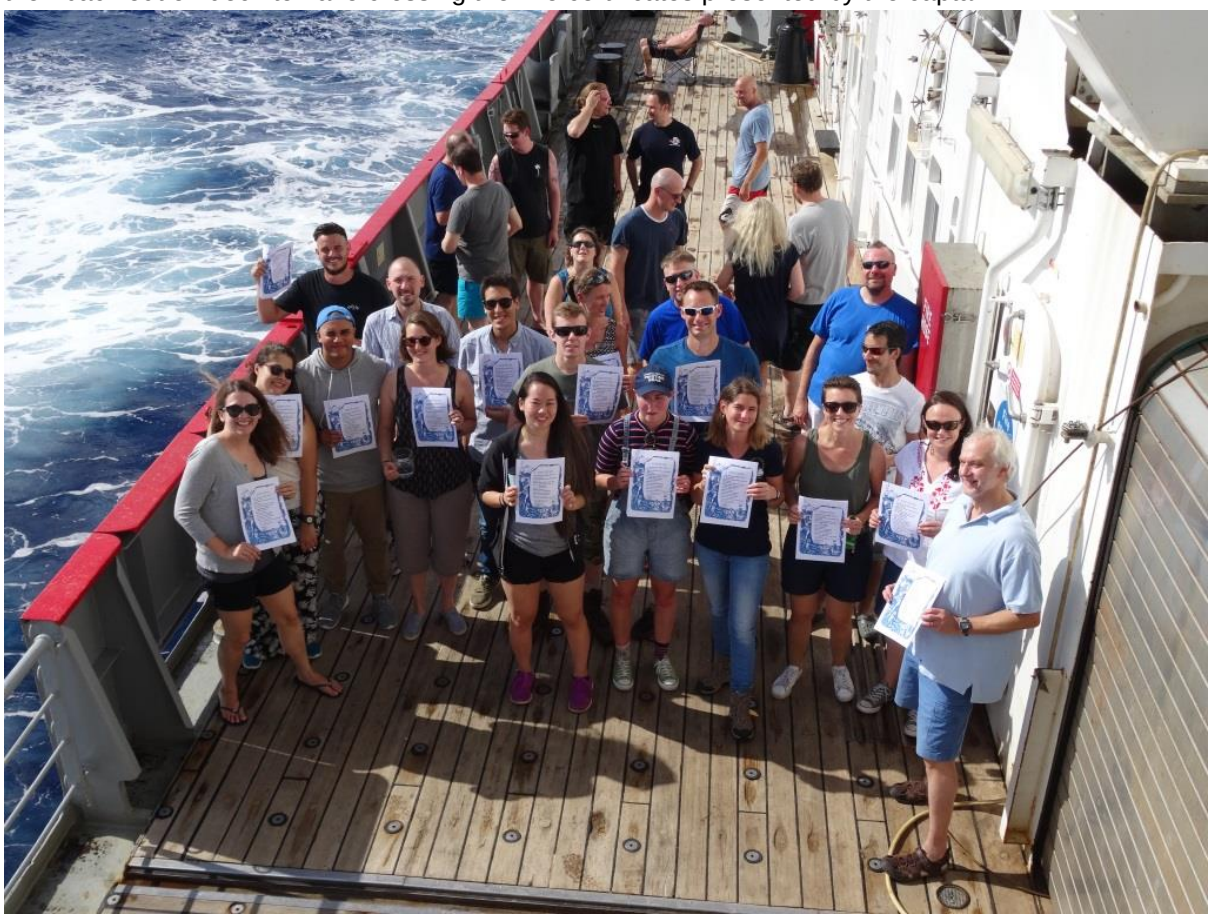
Saw Purser. Current plan for Stanley – 3rd officer arriving 25th Oct. Will be on ship as soon as we arrive. Fred share with me. All off ship 1500 on 31/10/18.

Email to Andy Rees, PML.

Crossing the Line ceremony today. 19 Pollywogs in total. Preparations are at fever pitch. Pretty certain the pollywogs are up to something. Mind you, if I was part of a group of 19 and there were only 10 police coming to find you all, I'd be preparing means of repelling borders as well.

Briefing for pollywogs: 1140

1315: Captain welcomes King Neptune, Queen Amphitrite and their entourage on board. Pollywogs go and hide. Police find them and bring them before the Court of King Neptune to answer charges relating to crimes committed prior to and whilst being on the ship. If found guilty (a done deal) sentence is then carried out. This is where a barrel of food slops and a ladle come in handy. Then it's get hosed down to get rid of the worst of the slops, have a shower, possibly have another shower and then back out on deck to have crossing the line certificates presented by the captain.



At the BBQ, Mackem mentioned how impressed he'd been with the complete team effort involved in recovering the float; from down in the bowels (maintaining 13.5 knots) to lookouts and steerage on the bridge.

10 October

Predawn station AT the equator. – Equator pics, get.

Time 06:22 GMT

Position: 0 degs N/S, 25 degs W. Predawn station at the equator

Heading 180

Speed 10.4 knots

Sea state 3-4

Sky starry

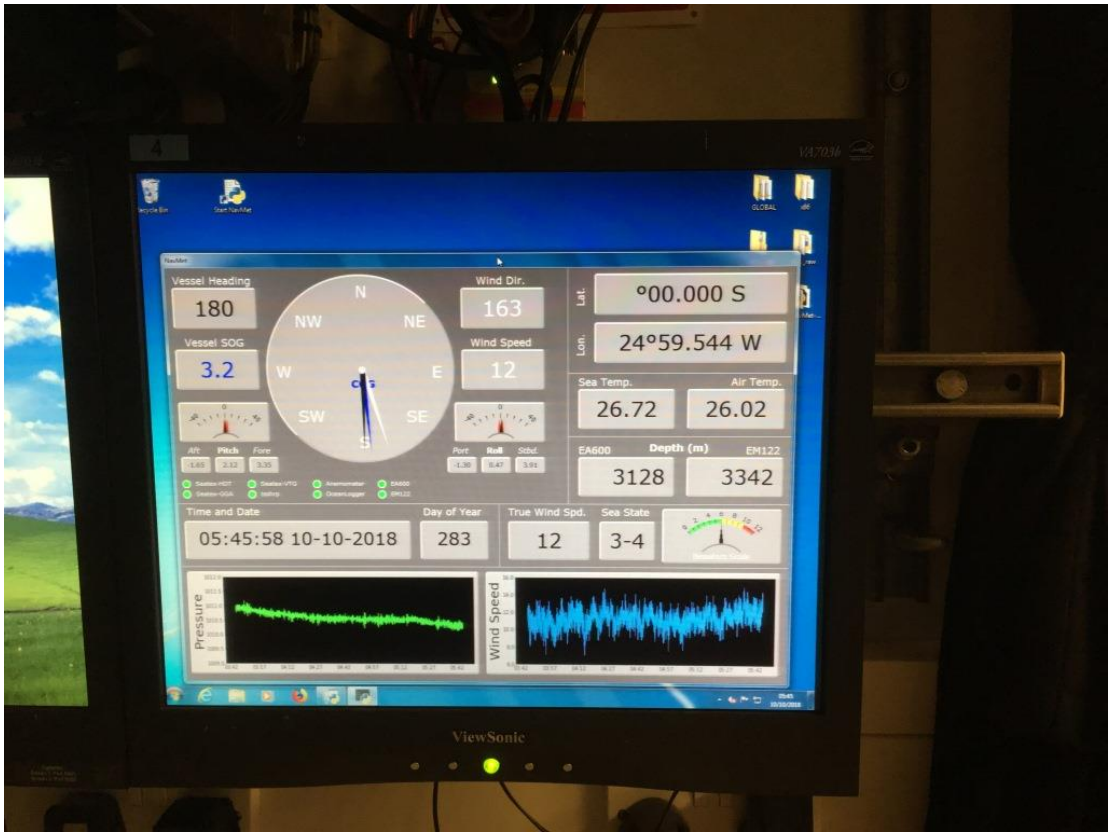
Email people re. float deployments – Lynne Talley, Fiona Carse

Deal with group pics from crossing the line

Next deep CTD planning -Down to 4200 m to test acoustic releases for mooring. Need to make sure station is in deep enough water. Also, needs to be in the southern gyre i.e. south of 9^{o}S. From current lat., at a speed of 10knots = 21h 15 mins = 213 nmi. 213/60 ~ 3.5^{o} a day. 10.5^{o}S. Deep CTD time will be noon on 13th Oct. Start station at 1030.

Deploy first float at noon on 14th Oct.

Note: Portuguese man o' war seen at the noon CTD station



11 October – Starry, a few clouds

Today = 18 days into the cruise and 18 days to go = Halfway Haribo day.

1230 – Met with John re. float deployments

He wants approx. 22 bottles from 1500-1600m and the surface. John to provide a list of all depths.

At each depth: nuts, pH (1 L, pickled samples, HgCl2), also a duplicate depth for pH

At surface and DCM: POC (7 L), HPLC (7 L)

O2 – Would like approx. 6 depths for calibration – John to ask Carol

After all deployments completed, would like another FLBB deployment to 500 m.

ALL floats are pressure activated.

All SOCCOM floats are sponsored by schools.

Looks like deployments will have to be limited to noon because nowhere near enough water/bottles at the predawn station.

Bob – Suspended temperature sensor. Covered it in foil. At the noon CTD deployment it appears to have been eaten by a fish/squid. Sean tried to locate a new sensor but couldn't find anything that was stand-alone. Only had wired sensors. Bob will use his spare fin.

1st officer is looking for gas cylinders. Ian – 2x OFN, Charel, 4 cylinders. Both sets of cylinders are for JR18005/Andrex II.

12 October- Starry, a few clouds

Carlos caught a squid whilst the CTD was in the water.

Send a copy of Charel's manifest to 1st officer.

Question from 1st officer – What's the weight of the batteries in the floats? Found the answer in the UW (SOCCOM) float manifest.

Helped Ian get acoustic releases up and running and 'talking'

13 October – Cloudy, Rain. Lumpy F5-6

Get Daz's carboys ready for today's CTD to 4200 m at 1030.

0100 – prop motor failure. Reset straight away without further issues.

Tomorrow – Net. Go to 250 m to collect more material for Natalia.

Float plan to Fred. He will help with float deployments, along with me.

Today, position of CTD was 12°S. Position of SAG mooring is 18.5°S = 6.5° difference

On station 3.25 h = 1345.

Ship speed approx. 10.5 knots

ETA at 15°S = 180/10.5 ~17 h = 0645, + predawn station of approx. 1.25 h = 0800 at 15°S.

Position at 0430 ~ 14.6°S. Suggest slowing ship to 1 knot at 0900 to deploy UW float s/n 12691 and Met Office float s/n 7001.

Notice – No bones, T bags into slops bin because macerator can't cope.

Send CTD36 bottle file to Daz

4200 m CTD – Nice and sunny, F4. In water at 1033 GMT

Got to 4200m at 1147 GMT.

Ian successfully pinged both acoustic releases. 1 returned a depth of 4185 m, the other returned a depth of 4187 m.

CTD out of water at 1338 GMT. Total of 3 h 5 mins.

Daz's samples – All of bottles 1 and 2. Both at 4200 m. Did a single rinse on both bottles of between 0.5 – 0.75 L, then filled.

14 October – Starry F3-4

Bongo to 250m to try and get more plankton for Natalia. Also ask Igor to be gentler with the hose.

Get tools and shackle bucket ready for mooring.

Send boxlist to Becca and Wade for end of cruise packing.

15 October – SAG mooring Day.

Had a meeting on aft deck for all people involved with the mooring. Mooring first pinged at 0713. Range given as 5270 m. Ian sent release command, received OK message. Didn't realise bridge had not authorised release. Protocol – Range it and then choose a safe distance for the ship. Bridge estimated vessel position from mooring of approx. 300 m. ship slowly moved backwards until 800-900 m from likely position of mooring. When vessel was stationary, repinged the mooring (at 0816). Reading of 3790 m. 5270 – 3760 = 1480 m in approx. 1 hour.

Approx mooring ascent speed = 1480/60 = 24.67 m per minute. This value was very slow. Lower floats probably imploded. With total mooring length in the region of 3000 m, top of mooring surfaced at 0905 GMT. Mooring all recovered approx. 1130. All lower set of floats had imploded. Mooring deployment began at 1200.

Anchor chain dropped at 1632 in location 18° 32.7016'S, 25° 4.8100'W.

Kept on pinging the mooring on the way down until got 3 constant readings. Did not carry out triangulation of mooring to confirm final position.

1736 – ship back on passage.

Helped Ian collect samples from the sediment traps. 21 bottles per trap. First, tested pH with strips. pH varied from 7.0 – 8.5. Then, parafilm placed on top of bottle and then lid screwed on. Bottles were put into small Mailboxes with lots of blue roll and then placed in the CT lab at 4°C.

16 October – Starry. Cloudy by 0800

Deployed UW float s/n 12632 at 0535 (GMT).

Next floats at 25°S and 26.5°S

Question – Will get to southernturn at 24°S on 17/10/18 at approx. 0430 ship time?

After this, distance from 24°S to 25°S is approx.. 85 nmi (Pythagoras)  . Sides = 60 nmi, squares = 7200, hypotenuse = square root of 7200 = ~ 85 = 8.5 hours travel time.

26.5°S is approx. 206 nmi from 24°S. Went to verify with Dominik at 1430 (ship). Correct.

Oven in prep lab has not been working. ETO has checked it out, replaced 2 fuses and it is now working again.

17 October – Mix of clouds and stars

Station at southern turn, 24°S, 25°W.

Still an issue with Niskins not sealing and it is getting worse, according to Carol.

The best thing to do would be to replace the rubber tubing with spring and rope/cat gut lanyards. Basically, the rubber tubing is nowhere near strong enough to hold the end cap in place with 20 kg of water above it, once the vent has been opened and atmospheric pressure comes into play. Sean reckons the problem gets worse as the tubing gets older as it gets 'tired'. I checked with a few people and it turns out there are too many leakers to count, but the worst offenders are 5, 9, 16, 21. 16 also has a tap which is difficult to open/close. Leakage gets even worse as the ship rolls. Told Sean – He will tighten the 4 worst offenders and will swap out 23 and 24 with spares for the noon CTD that have had the rubber tubing replaced with springs.

Approx. distance from southern turn to Port Stanley. Port Stanley is at 51° 42'S, 57° 51'W. Google maps gives the distance as 2235 nmi. At a speed of 10 knots, that's approx. 10 days. Add in 10 day's-worth of science at 2.75 h d^{-1} and 6 SOCCOM floats at 30 mins each you get an additional 30.5 h. Total = 11 days 6.5 hours.

18 October - Starry

Deployed Met Office float s/n 7589 at 0539 GMT

1030 – "Noon" station at 27.2°S to allow for 1500 m CTD and deployment of first 2 SOCCOM floats. s/n 12696 and 12883. Need to be deployed in the right location to hopefully get into the Brazil Current. Needs to be >2000 m deep and before the Rio Grande Rise.

Distance from 27.2 to 33°S = 431 nmi. Leave 27.2°S at approx. 1230. 431 nmi at 10 knots = 43.1 h = 1 day 19 h, plus 3 stations, totalling approx.. 6 h. Therefore, time to get to 33°S will be approx. 2 days = approx. ETA of 1230 on 20 Oct. Next SOCCOM float deployment will therefore be 1300 (ship) on Sat 20 Oct.

Next Met Office float, at 34.5°S will be at the noon station on 21 Oct.

Note: 3 prop motor failures during the night

Note: at the 1030 station there were 3 large black petrels at the stern of the ship.

Gear returning to the UK.

PML Container – Me, Becca, Wade, Giorgio, Bob, Andreia, Afonso, Arwen, Natalia – 18-19 cubic metres

NMF storage container – Ian, Hans, Millie, Carol, Chata, Cecilia, Igor, Fred, John, Alyse, Jenna. Scientists' kit, approx. 12 cubic metres. NMF kit ???

Check people's onward travel. Igor and John are both flying LATAM.

19 October – rain, followed by stars

UEA – 2 x dry shippers going to be couriered to Concepcion, Chile, probably on the same flight as Igor. He is arranging their pickup from the ship by the courier. Will have lots of frozen samples to leave on board. Lugol's samples will go in the PML container.

Alyse/Jenna – Yeti cooler. Will take back on the flight with them.

Make sure lab will be open when we return on Saturday 3 Nov.

Book minibus travel.

1st officer said that each container will need a container packing certificate. Blank form on the shared drive in the cargo paperwork folder. Containers = PML, NMF storage, 2 x RN container.

As the containers leave the ship they will be weighed via load cell. All containers will be non-haz.

The RN containers will require decontamination certificates. Again blank copy on the shared drive.

Hans/Mille will have rad samples for cool stow – Use my fridge? (not used in the end)

Waste – Class 7 will go in no. 1 hold, Other waste in No. 2 hold.

Current demob plan.

Containers off forward, then 2 containers out of forward hold. Everything out of the port wing and then the stbd wing to get equipment out for transport to Rothera. (Foremast equipment off in bird cage at some point). Then, containers off the aft deck. 3 containers from forward then go on the aft deck, 2 containers back in the forward hold and 1 on the hatch. And, also, at some point, demob AMT28.

Gear off monkey island

PML gas stillage – HazBol – 5 x He, 2 x OFN from NOC.

Foremast – Fred/Bob need to be ready to dismantle gear immediately, if necessary.

Class3 chems will go into 10' container outside the UIC and stay until the UK.

EtOH needs to be classed as waste to avoid duty being charged on arrival in the UK.

BOL numbers – Use the Visiting Scientists section in the Assigned Bol numbers excel file.

Note: Good possibility we will have to berth at Mare Harbour instead of Port Stanley.

20 October - Cloudy and windy. F5-6.

By end of predawn station, wind at +30 knots.

The SOD was more like a kite.

200 µm net – net parted company with the canvas at the opening over 1/3 of the circumference.

Will need a new net for next year.

At end of station we were stationary for over ½ an hour.

Find out about end of cruise data. Arwen will take a complete copy. She will ask SeanV or David to do it.

RN container decon. Certificates. Signed by the captain. Originals to NMF. Copies to captain and BAS H & S advisor, Jenny Forster-Davidson.

Noon CTD – 2 humpback whales around the ship until we left station. Possible mother and calf.

Note: Possibly rough Mon/Tue.

21 October – Stars and clouds

0400 – Wind 26-30 knots – cancelled net.

Clocks – 3 hours to go back. retard on 24, 26 and 28 Oct.

PCA – ship downtime, AINMEs – ask captain for details, Other downtime – cruise shortened by 1 day to enable equipment transfer to Rothera. PCA v1 written.

an Brown – BOL, gases

Met Office float 8065.

22 October – Cloudy

Email Jez to let him know about possible/probable demob at Mare Harbour.

Container numbers.

PML – PSSU 336650 3

NMF RN1 (Hans/Millie) – NMFU 200225 2

NMF RN2 (Natalia) - NMFU 200224 7

NMF storage container – TCIU 452968 1

Drill 1030 – Into lifeboats. Video on liferafts.

Noon station – Should arrive at 37^{o}S. Next Met Office float nominal deployment latitude is 38^{o}S. Decided with Fred to deploy at this station because of poor weather forecast. Float s/n 8065.

23 October - Cloudy, F5-6

Managed predawn CTD and SOD. No net. At start of station sea state was F5-6 by the end we were at F6-7, wind speed getting up to 35-45 knots. Position 38^{o} 36' S, 40^{o} 41' W.

At 0730, approx. 1063 nmi to go. 6 days at 177 nmi per day. Perfect timing, if all goes well.

1215 – Large 4-5 m waves, sea F6-7, gusting 30-39 knots. If can't do CTD and deploy float, do additional CTD tomorrow?

Potential programme: 0430 (1.5h), 0830 to 1500 m (2h), 1300 (1.5h).

Currently travelling at 7.5 knots. 24 h = 180 nmi, approx. 2 degrees of latitude. If stopped at 0830 we would be approx. 30 nmi short of 40^{o} 50'S. If didn't do this and went to 0430 next day, looking at a further 20h at say 9 knots = a further 2 degrees of latitude = 42^{o} 50'S.

24 October – Rain, cloud, moon and stars.

Clocks to back to GMT-1 hour tonight

No net. Still large swell. Wind 30 knots at 0410. Wind dropped off on station

John – working late on SOCCOM float days.

Andreia – Unused Lugol's boxes?. Lugol's samples back to UK in container.

Bob – Question – space for an extra cryobox of AFC samples in his cardboard box to be left in the -80C freezer until back in the UK? Yes. Box: 43 x 26x x26 cm.

Check PML container Tare

Safety meeting – 1030, 24/10/18, conference room.

Correct labelling on chems, end of cruise rad things.

Aisling asked how I know 0.5% glut was non-reg wrt IMDG. Told her I'd just Googled it and gave her an MSDS for 2.5% glut used as a disinfectant, which was non-reg. Aisling said that 1st officer had been given an Excel spreadsheet for calculating whether a certain concentration of HgCl2 was hazardous or non-reg. (Got it from 1st officer. Had been created by Marie Jose Messias, Exeter Uni).

Asked Aisling for details of waste drums so far, with their locations.

25 October

Northbound BOLs – Ask 1st officer that the port of discharge will be. Answer – TBC

Let 1st officer know about the courier coming to pick up Igor's dry shippers.

Send PCA draft to captain and ask for AINME details

End of cruise scientists' meeting – Sunday 1030

Giorgio – BGC float return. Use the double UW float box. 206 x 56 x 43 cm. Weight 114 – 40 = 74 kg.

Class 7 DGNs for waste (Didn't need them in the end because non-haz). No-one at PML. ?Claire Evans? – Yes

Cruise picture for ship – Artwork – Millie and Jenna.

26 October – Cloudy

Went close to icebergs! One at 0930 and one at 1000 Approx location – 45.5^{o}S, 49.4^{o}W.

Noon station – Andreia came to let me know she would not be sampling on 27 Oct. When I asked why she said it was because she only had 3 filters left for coccolithophore filtration. Using 47 mm 0.45 µm cellulose nitrate filters. I gave her a pack of filters and a pack of 55 mm petri dishes. Arwen and Wade also told me they only had 1 Sterivex left each. I gave Arwen 5 extra and Wade an additional 1 Sterivex.

Comms blackouts during the morning. Phone and internet.

27 October – Partly cloudy, nice and calm

Last day of science. Predawn and noon stations.

Do end of science presentation

Do cabin packing

Incubators – dismantle

FCMs – Once all sampled analysed, Decon for 30 mins and then 30 mins MQ.

Download AFC data.

Download Legwork shared drive

Lead weights – bring aft

Bongo log – send to Igor and Natalia

Sort out samples remaining on board – cool stow. +4C, -20C, -80C

Laminate cylinder BOLs for Ian's OFN on the boat deck.

BOL list – 1st officer

JR18005 – Manifests and gas BOLs

ICEBERG approx.. 0950 – 1030

Circumnavigated it twice, just a few 100 yards off so that Bob could get underway measurements in the wake of the berg as other studies have indicated that bergs fertilise the ocean as they go.

Met with Aisling to deal with waste and unused chems. She is happy to deal with it all.

Arrange to meet with everyone who has unused chems at 1400 on Sunday to move all chems into the science hold to pack them.

Got results regarding the 32Si source: activity 87330 Bq – Exempt. Not even classed as radioactive in France.

28 October

See Mackem – access to hold

See 1st officer – dry shipper courier

See Rob – turning off underway after lunch and underway event log.

Cabin inspection 1530

29 October

Arrival Mare Harbour – after breakfast.

Samples onboard - PML, NOC

Natalia – 1 cryovial box – in with PML sample box in -80C freezer. 2 boxes of glass vials and 1 UN box of 15 mL Falcon tubes containing samples pickled in EtOH, both in -20C freezer.

UEA – Lots of boxes in -20 and -80C freezer including dust filters.

Hans/Millie – 1 box at -80C and 2 stacks of boxes at -20C

John – 6 large blue boxes containing TA samples pickled with HgCl2. Consigning to someone on JR18005

Igor's samples.